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CONTENTS

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A NEW SPECIES OF BAUHINIA (FABACEAE) FROM BAHIA, BRAZIL

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An unusual species of Bauhinia (Caesalpinioideae: Cercideae) from Bahia Province, Brazil and belonging to the Divaricata alliance (Wunderlin, 1983) is here described. It occurs approximately 6,000 km distance from the rest of the species of the group.

BAUHINIA PINHEIROI Wunderlin, sp. nov.

Bauhinia erythrocalyx Wunderlin et B. jenningsii P. Wilson affinis, a qua imprimis differt staminibus fertilis tribus.

TYPE: Brazil: Bahia: Km 25 on the Guaratinga-São Paulinho road, 2 Apr 1973 (fl), Pinheiro 2081 (holotype, CEPEC; isotype, K, US).

Shrubs to 3 m; branches slender, glabrous. Leaves with blades chartaceous, suborbicular, 10-15 cm long, 11-14 cm wide, 7-nerved, bilobed 1/2 to 2/3 their length, lobes divaricate, apices of lobes obtuse to acute, bases of blades cordate, upper surfaces glabrous, lower surfaces sparsely and minutely strigulose to glabrate, petioles 3.0-3.5 cm long, canaliculate, glabrate; stipules lanceolate, ca. 1 mm long, persistent; intrastipular trichomes minute, abaxial one occasionally enlarged and forming a subulate excrescence ca. 1 mm long. Inflorescences terminal, racemose or paniculate, ca. 15 cm long, 24-30-flowered, strigose or stigulose, flowers usually in 3's, peduncles adnate to rachis and emerging between next and second higher nodes; buds fusiform, 2.0-2.5 cm long, apices long acuminate, with free setaceous tips up to 1 mm long; pedicels 4-5 mm long; bracts and bracteoles linear-lanceolate, ca. 1 mm long; hypanthia urceolate, 5-7 mm long, slightly inflated; calices spathaceous at anthesis; petals 5, yellowish-white, subequal, glabrous, erect to slightly spreading, elliptic, 1.5-1.8 cm long, 4-6 mm wide, apices caudate, claws 4-5 mm long, margins undulate; fertile stamens 3, abaxial, filaments 13-14 mm long, short-connate to outside of staminal sheath for 2-3 mm, glabrous, anthers ca. 6 mm long, sparsely pilose at base, otherwise glabrous; pollen peroblate, 3-colporoidate, sexine reticulate; staminodes 7, 8-10 mm long, without aborted anthers, 2 adaxial ones of outer whorl connate

with staminal sheath 2-3 mm (same level as 3 fertile ones), those of inner whorl irregularly connate for ca. 1/2 to nearly their entire length and forming a laciniate margined staminal sheath, inner surface of staminal sheath and hypanthium wall short antrorsely brown-pilose; gynoecia ca. 12 mm long, enclosed within or slightly exceeding staminal sheath, glabrous, ovaries 3-4 mm long, gynophores ca. 6 mm long, styles ca. 2 mm long, stigmas obliquely capitate. Fruits (immature) linear, apiculate due to persistent style base, chestnut brown, glabrous, reticulate, 7-8 cm long, 1.5 cm long, gynophores glabrous, 1-1.5 cm long; seeds not seen.

ADDITIONAL SPECIMENS EXAMINED. BRAZIL: Bahia: Fezenda Pau-Brazil, ca. 5 km NW of Itamarajú, 3 Jul 1979 (fl, y fr), Silva et al. 529 (CEPEC).

The species is named in honor of the first collector, Raimundo Soares Pinheiro of the Centro de Pesquisas do Cacau, CEPLAC, Itabuna, Bahia, Brazil.

The Divaricata alliance of *Bauhinia* (Wunderlin, 1983) is a Middle American (except for *B. pinheiroi*), arborescent group of 17 species characterized by the reduction of fertile stamen number from 10 to one or rarely three. Within this alliance, 15 species have a single fertile stamen and two, *B. coulteri* of central Mexico and *B. pinheiroi* of Bahia, have three fertile stamens. Although both are similar in regards to fertile stamen number, they do not otherwise appear to be closely related. Rather, *B. pinheiroi* appears more related to the monandrous taxa *B. jenningsii* of the Yucatán Peninsula and Isla de Pino, Cuba, and *B. erythrocalyx* of the Yucatán Peninsula. These three species have similar floral characteristics and share a pollen type (peroblate, 3-colporoidate, exine reticulate) otherwise unknown in the genus. The monandrous condition is considered derived in the alliance, therefore, the triandrous *B. pinheiroi* and *B. coulteri* may represent relictual taxa now widely separated and the similarity of *B. pinheiroi* to *B. jenningsii* and *B. erythrocalyx* may be the result of convergence.

LITERATURE CITED

Wunderlin, R. P. 1983. Revision of the arborescent Bauhinias (Fabaceae: Caesalpinioideae: Cercideae) native to Middle America. Ann. Missouri Bot. Gard. 70: 95-127.

EFFECTS OF 2,4-D AMINE ON ROOT MORPHOLOGY AND MINERALS OF ZEA SEEDLINGS

By

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ABSTRACT

In growth chamber studies, 10 p.p.m 2,4-D amine increased the number of seminal roots, reduced lateral root production, decreased root extension, caused root tips to swell and reduced root dry weight of Zea maize seedlings. However 5 p.p.m. 2,4-D amine caused only slight damage. At the end of the 2-wk growth period, damaged seedlings showed signs of recovery, which included an increased number of seminal roots, development of normal root extensions from clubbed root tips, and development of normal lateral root patterns. 2,4-D amine increased percentage N, P and K in zea plants.

INTRODUCTION

There is a considerable literature on the effect of 2,4-D on higher plants as regards the physiology, morphology and biology of this group of plants when subjected to various treatment of 2,4-D. (Lee, 1972; Rensburg and Villiers, 1978 a & b; Arkhangel'skii et al. 1982 and several others). All these reports revealed that the lower concentrations of 2,4-D may be have as growth regulators, but at higher concentrations it has antiphotosynthetic effects on all tested plants.

Mc Cracken et al., 1981 showed that 2,4-D decreased chlorophyll content in many plants.

However, Zvyagintsev et al. (1975) demonstrated the increase in chlorophyll content of Calamagrostis arundinacea cells under the influence of wide range of 2,4-D concentrations.

As a result of 2,4-D applications to higher plants, the electrophoretic picture of the protein fractions was subjected to qualitative and quantitative changes and the picture have been considerably altered (Baker et al., 1980; and Zych, Monika, 1980). In this connection, Ladonin et al. (1980) indicated that the increase in cell protein of pea plants treated with 2,4-D was due to the herbicide-induced decrease in protein decomposition rather than to increased protein synthesis.

As regards respiration in 2,4-D treated plants, it was subjected, in most cases, to pronounced disturbances (Makovcovà et al., 1976). Chodovà (1980) indicated that respiration rate is a sensitive criterion of the action of 2,4-D, since the consumption of O_2 in 2,4-D-treated plants of Sinapis alba was significantly decreased by continuous

exposure to the herbicide; a phenomenon that was accompanied by a concomitant decrease in protein and sugar contents of cells.

Halvankar and Patil, (1983) came to the conclusion that the germination percentage of presoaked seeds of durum and bread wheats decreased if treated with high concentrations of 2,4-D. According to Holmes and Kapusta (1980) the addition of 2,4-D amine at several rates to soybean plant resulted in a significant decrease in the yield.

Little information is available about the effects of herbicides on the minerals of plants. Most studies have examined whether a nutrient will alter the phytotoxicity by some interaction in the soil or plant. Sameni et al. (1976) exposed sunflower plants (Helianthus annuus L.) to some herbicides and observed a non-significant increase of percent nitrogen in leaf and stem tissue.

MATERIAL and METHODS

For this investigation Zea maize plant was chosen. Seeds were washed with water sterilised with 1 % H_2O_2 and washed again. The seeds were then air dried and sown in the soil which was air dried and passed through a 2 mm sieve. This soil had a pH 7.5 contained 3.09 % organic matter.

The soil was manured with fertilizer (1 g ammonium sulfate per 1 Kilo of soil as recommended by the Ministry of Agriculture), and 2,4-D amine herbicide at 0, 5 and 10 ppm was added and mixed thoroughly. Herbicide concentrations were determined in preliminary experiments such that the highest conc. 10 ppm would cause considerable damage to zea seedlings without being lethal.

Containers used for growing plants were constructed from black plastic plumbing tubes, which had a 5.1 cm inside diam. and were 55 cm long. The tubes were cut lengthwise on one side to facilitate later soil removal. The longitudinal cut was sealed and one end of the tube was fitted with a rubber stopper. Two strong rubber bands were placed around each tube to prevent opening of the cut during the experiment. Tubes were filled with either control soil or herbicide-treated soil. Each tube was seeded at the 2.5-cm soil depth, and wre placed randomly in a growth chamber at 22^{o}C. The relative humidity was approximately 45 %.

Plants samples were taken at 3, 6, 9, 12 and 15 days old. At each sampling date the cuts along the tubes were opened slightly, the soil was then washed away to recover the entire root system. Measurements were then made on the seminal and lateral roots. The seminal root diameter was measured using a microscope with a calibrated micrometer eyepiece. The root systems wre then oven dried to measure dry-weight production.

Other samples were taken at 21 and 35 days-old. Their roots were washed free of soil and separated from the shoot material.

Both roots and shoots were oven dried, finely ground and subjected to the H_2SO_4-H_2O_2 digestion procedure described by Thomas et al. (1967). Nitrogen and phosphorus wre analyzed with an auto analyzer, calcium, magnesium and potassium with an atomic absorption spectrophotometer.

RESULTS and DISCUSSION

The primary root systems of the 15-days old control plants were well developed and the secondary were just beginning to develop. Total dry weight of the 15 days old plants was significantly reduced by 10 ppm herbicide, whereas 5 ppm had little effect as shwon in Fig. 1. This indicated a threshold phytotoxic response that occurred between 5 and 10 ppm 2,4-D amine under the conditions used in this expriment. Three days after seeding the first three seminal roots had developed regardless of herbicide conc. . The number of seminal roots was relatively constant by day 9 for control, with an average of 4.8/plant by the fifteenth day. Seminal root numbers of the 10 ppm herbicide-treated plants remained constant after 6 days with an average of 5.8/plant. The 5 ppm herbicide-treated plants were intermediate with an average of 5.1 to 5.7 for the 12- and 15-days old plants, respectively. Thus, a stimulatory response from 2,4-D amine caused the zea seedlings to produce more seminal roots. No reports of a similar effect could be found in the literature. The maximum number of seminal roots a wheat plant can produce is six (McCall, 1934 and Peterson, 1965).

2,4-D amine at 10 ppm reduced the total seminal root length per plant of the 15-days old plants to approximately one-third the length of the controls (Fig. 1). The increase in the number of seminal roots did not compensate for the reduction in total seminal root length at this growth stage. The 5 ppm treatment did not significantly affect total seminal root length per plant compared to the controls.

Root diameters ranged from 0.442 to 0.553 mm for the control plants (Table 1). Percival (1921) has reported diameters for seminal wheat roots of 0.50 to 0.75 mm. Seminal root diameter appeared to be a function of plant age since the diameter generally decreased with time independent of the herbicide concentration.

2,4-D amine concentration of 10 ppm increased the average root diameter. The increase in radial expansion was greatest near the root tip giving the roots a club-like appearance. The root diameters were not significantly increased by 5 ppm conc. Lateral roots were not present by day 3 but were beginning to develope 6 days after seeding. 2,4-D amine at 5 ppm tended to reduce the average lateral root length with day-9 and day-15 plants significantly different than the controls (Fig. 1). The 10 ppm conc., instead of further reducing the average lateral length, was either equal to the 5 ppm value (day 12) or significantly higher than the controls. This response by the lateral roots to the higher herbicide concentration can be atributed to the production of abnormally long lateral

Plant age (days)	Herbicide Conc. (ppm)	Average seminal root diameter (mm)
3	0	0.553
	5	0.578
	10	0.617
6	0	0.509
	5	0.517
	10	0.589
9	0	0.471
	5	0.504
	10	0.582
12	0	0.442
	5	0.459
	10	0.520
15	0	0.453
	5	0.455
	10	0.528
LSD		0.040

Table 1: Effect of 2,4-D amine on the diameters of seminal roots of zea seedlings.

roots. This is of importance since the number of lateral roots produced per cm of seminal root is significantly lower for the 10 ppm treatment compared to the 5 ppm treatment (Fig. 1), whereas the total production of lateral roots from the 10 ppm and 5 ppm treatments does not differ significantly.

The zea plants appeared to have a compensating mechanism for the reduction in growth of the parent seminal roots at the higher conc. of 2,4-D amine. However, this compensation was unable to completely offset the reduced total lateral root production (Fig.1). The lateral root data also shows that the reduction of total lateral root length per cm of seminal root by 5 ppm herbicide was due to a reduction in the average length per individual lateral root and the reduction of 10 ppm herbicide was mainly due to a reduction in number of lateral roots produced.

Barrentine and Warren (1971) found that the production of adventitious roots in sarghum bicolor increased in the shoot zone overlaying herbicide-treated soil layer in the upper root zone. These reports suggest that plants compensate for root inhibition in herbicide-treated soil by growing roots outside the herbicide-treated soil in the initial dose is not lethal. Our data show that damaged zea

roots can recover within soil treated with a nonlethal dose of 2,4-D amine.

Root and shoot dry weight of the zea plants was significantly reduced by 10 ppm herbicide, whereas 5 ppm herbicide had little effect (Table 2). This reduction at 10 ppm was less for the 35-days old plants than for the 21-days old plants.

Plant part	Root					
Plant age (days)		21			35	
herbicide conc. (ppm)	O	5	10	0	5	10
Dry wt (mg)	81.9	82.4	30.9	229.7	204.5	144.1
LSD	20.8					

Plant part	Shoot					
Plant age (days)		21			35	
herbicide conc. (ppm)	0	5	10	0	5	10
Dry wt (mg)	166.8	161.9	63.4	416.6	392.2	351.4
LSD	36.9					

Table 2 : Effect of 2,4-D amine on dry weight of zea plants.

Results from the plant tissue mineral analyses showed percent Ca and Mg increased and percent K, N, and P decreased as the herbicide concentration increased (Fig. 2). These effects were less pronounced in the older plants, indicating the plants were overcoming the herbicide effects in later growth. The increase in percent Ca and Mg were not due to the reduction of plant biomass caused by 2,4-D amine, since dry weight production was unaffected by 5 ppm conc., but the percent Ca was greatly increased (Fig. 2). Furthermore, if it had been a concentrating effect, the percent N, P, and K should have increased. Mg was less affected than Ca and by day 35 the percent Mg had returned to normal but the percent Ca was still higher than in the controls.

Generally, percent K increased in the roots and decreased in the shoots of the 21-days old plants grown in herbicide-treated soil. Possible K movement into the shoot material may have been restricted causing an accumulation of K in the roots relative to the

control values. There is evidence that some herbicides reduced the transport of two photosynthetic herbicides, atrazine and simazine, from the roots to the shoots of pea and soybean (O'Donovan and Prendeville, 1976).

Percent P content for the 21-days old plants grown in the 10 ppm herbicide-treated soil, was reduced 56 and 44 % in root and shoot tissue, respectively. The reduction was less with the older plants. P content expressed as shoot-to-root ratio was not altered by 5 ppm of 2,4-D amine, indicating that the reduction of percent P was similar throughout the plant. However, 10 ppm reduced the ratio and thus showed a greater reduction in the shoots than in the roots.

N was less affected by 2,4-D amine than the other nutrients examined. Nevertheless, herbicide-treated plants had significantly reduced percent N at both concentrations (Fig. 2). Sameni et al (1976) have observed a non-significant increase in percent N in leaf and stem tissue of sunflowers exposed to some herbicides.

These results show that zea seedlings are capable of recovering from sublethal concentrations of 2,4-D amine and that both root morphological and plant minerals concentrations undergo changes.

REFERENCES

Arkhangel'shii, N.S.; Kostrikin, V.M.; Gruzdev, L.G. and Luzik, L.V. (1980): Yielding capacity of different fodder beet cultivars and protein and amino acid content in the roots after using 2,4-D as a growth regulator. Izvestiya: Timiryazevskoi Sel'skokhozyaistvennoi. Akademii. 2: 40-47.

Baker, R.L.; Powell, J.; Morrison, R.D. and Stritzke, J.F. (1980). Effects of atrazine, 2,4-D and fertilizer on crude protein content of Oklahoma, USA tall-grass prairie. J. Range Manage. 33: 404-407.

Barrentine, W.L. and Warren, G.F. (1971). Differential phytotoxicity of some herbicides. Weed Sci. 19 : 31-37.

Chodová, D. (1980). The effect of the herbicide 2,4-D on some physiological processes in the plants of white mustard and scenthess mayweed shortly after application.Ochr. Rostl. 16: 137-145.

Halvankar, G.B.; Patil, V.P. (1983). Effects of agrochemicals on germination in tetraploid and hexaploid wheats. Biovigyanam-a, 1, 27-32.

Holmes, R.L.; Kapusta, G. (1980). Soybean tolerance to and weed control with 2,4-D amine. Proceedings North Central Weed Control Conference, 1979. Weed Research 1980. 34: 34-35.

Ladonin, V.F.; Chesalin, G.A.; Samoilov, L.N.; Spesivtsev, L.G. and Taova, V.I. (1980). The application of N^{15} to investigating the influence of herbicides on crop and weed plants. Report 2. The action characteristics of herbicides on the nitrogenous metabolism of resistant and susceptible plants. Agrochimiya. 17: 116-122.

Lee, T.T. (1972). Changes in indoleacetic acid oxidase isoenzymes in tobacco tissues after treatment with 2,4-D. Plant Physiol. 49: 957-960.

Makovcová, L.; Sindelar, L. and Polak, Z. (1976). Changes in respiration and BSMV concentration of infected wheat plants after treatment with 2,4-D. Biologia Plantarum. 18: 190-194.

McCall, M.A. (1934). Developmental anatomy and homologies in wheat. J. Agric. Res. 48: 283-321.

Mc Cracken, D.A.; Ort, D.R. and Nadakavukaren, M. (1981). The effects of 2,4-D altered chloroplast development on photosynthesis. Physiologia Plantarum. 52: 285-291.

O'Donovan, J.T. and Prendeville, G.N. (1976). Interactions between soil-applied herbicides in the roots of some legume species. Weed Res. 16: 331-336.

Percival, J. (1921). The wheat Plant. London, Duckworth and Co. 463 pp.

Peterson, R.F.(1965). Wheat. Interscience Publishers Inc., New York, 422 pp.

Rensburg, A.J.J. Van and Villiers, O.T. DE. (1978a). Biochemical changes in Raphanus raphanistrum treated with 2,4-D. Agroplantae. 10: 1-3.

Rensburg, A.J.J. Van and Villiers, O.T. DE. (1978b). Effect of 2,4-D and MCPA on α-amylase and cellulose activity in roots of Raphanus raphanistrum. Agroplantae. 10: 5-7.

Sameni, A.M.; Maftoun, M.; Hojjati, S.M. and Shcibany, B. (1976). Effect of fertilizer-N and herbicides on the growth and N content of sunflower. Agron. J. 68: 285-288.

Thomas, R.L.; Shcard, R.W. and Moyer, J.R. (1967). Comparison of conventional and automated procedures for nitrogen, phosphorus, and potassium analysis of plant material using a single digestion. Agron. J. 59: 240-243.

Zvyagintsev, D.G.; Aseeva, I.V.; Samokhvglov, A.N.; Grishina, N.S.; Gorcharak, L.G.; Altakhov, M.D. and Gorcharuk, L.M. (1975). Improving hill pastures with the aid of 2,4-D butyl ester. Problemy Sel'skokhozyaistvennoi Nauki v Moskovskom Univ. edited by G.V. Dobrovol'skii: 306-323.

Zych, Monika (1980). Changes in the quality of grain, flour and bread of several wheat varieties occuring under the effect of herbicides, 2. The influence of herbicides on the milling and baking properties of winter wheat varieties. Hodowla Rosl Aklim Nasienn. 24: 23-36.

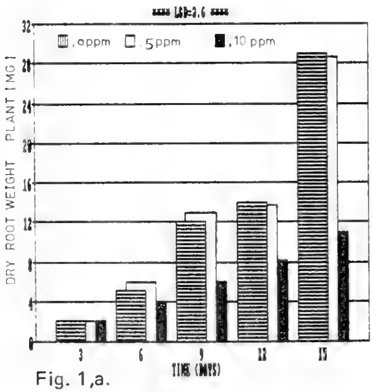
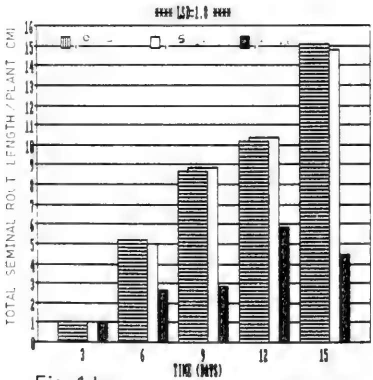


Fig. 1,a.



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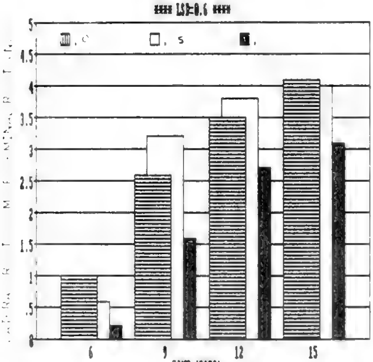

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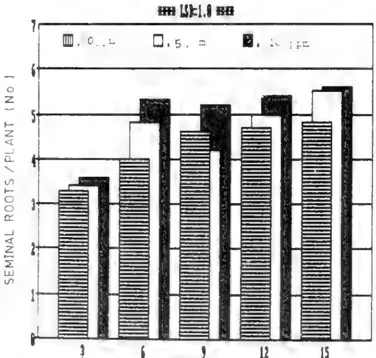

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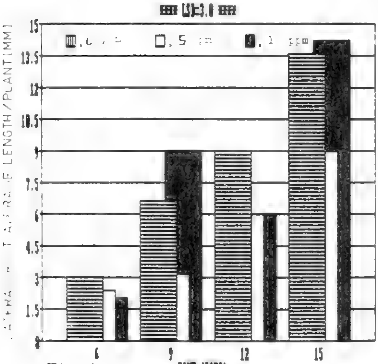

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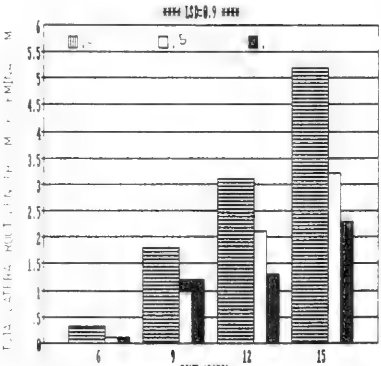

Fig.1,f.

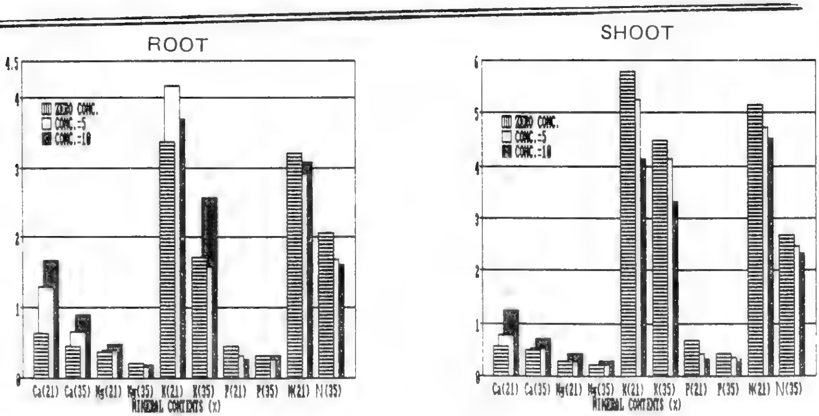

Fig (2) Effect of 2,4-D amine on the mineral contents of Zea plant

HETEROMORFISMO CRIPTICO EN LAS SEMILLAS RECALCITRANTES DE TRES ESPECIES ARBOREAS DE LA SELVA TROPICAL HUMEDA DE VERACRUZ, MEXICO.

Criptic Heteromorphism in the Recalcitrant Seeds of Three Arboreal Species from the Tropical Rain Forest of Vera Cruz, Mexico.

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ABSTRACT

Three species of trees with different levels of abundance in a patch of mature forest were selected: Nectandra ambigens, Cymbopetallum baillonii and Couepia polyandra. Their seeds were studied individually to determinate the length, width, thickness, wet and dry weight and humidity content. Also final percentage and speed of germination. The seeds showed considerable variability within and between individual trees (criptic heteromorphism). The morphological variability does not show a clear relationship with the germination data.

INTRODUCCION

El polimorfismo somático o heteromorfismo de las semillas se caracteriza por la producción en una misma planta de dos o más tipos de semillas que pueden diferir de modo tajante en forma, tamaño y comportamiento por lo que respecta a dispersión, latencia y germinación (Venable, 1985). Este tipo de heteromorfismo es frecuente entre las especies ruderales y en anuales de zonas áridas y semiáridas; en cambio, el heteromorfismo críptico entendido como la forma y comportamiento variable de las semillas que se presenta en forma gradual, es un fenómeno mucho más frecuente en la naturaleza que abarca especies de plantas de muy diversos medios y ciclos de vida (Silvertown, 1984). El heteromorfismo marcado puede ser el producto de un heteromorfismo floral y está condicionado geneticamente, en tanto que el heteromorfismo críptico puede originarse por las diferentes condiciones de desarrollo de las semillas que se dan dentro de un fruto, entre diferentes ramas o entre diferentes microambientes, aunque no puede descartarse la posibilidad de que parte del heteromorfismo críptico sea también condicionado por factores hereditarios.

Las semillas de muchos árboles tropicales presentan una variabilidad considerable en tamaño y contenido de humedad, tanto en las semillas producidad sincronicamente por los árboles de una especie en la misma comunidad, como dentro de la cosecha de un solo individuo (Janzen, 1977a, 1977b, 1978; Foster, 1986).

Por lo que respecta a la germinación de las semillas, la mayoría de las especies arbóreas de las selvas húmedas tropicales tienden a presentar una germinación rápida y practicamente simultánea después de la diseminación (Vazquez-Yanes y Orozco-Segovia, 1984), aunque también existen muchas especies que tienen una germinación gradual que se prolonga varios meses (Ng, 1980), lo que indudablemente es una forma de heteromorfismo.

La gran mayoría de las especies de semillas de las selvas humedas son recalcitrantes (Roberts, 1973); o sea, de talla grande, alto contenido de humedad, alta tasa respiratoria, poca tolerancia a las bajas temperaturas y limitadas posibilidades de resistir el almacenamiento. La latencia de estas semillas es corta o practicamente inexistente, ya que por lo general la germinación se inicia poco despues de la dispersión. Es posible que en algunos casos la talla grande y el alto contenido de humedad contribuyan substancialmente a amplificar la variabilidad en masa y que no se refleje en los valores del peso seco.

El heteromorfismo críptico de las semillas es un aspecto de la biología reproductiva que puede tener implicaciones ecológicas, por su relación con el establecimiento y la regeneración de las poblaciones; por ello, se decidió evaluar la importancia de esta variación en algunas especies de árboles tropicales.

MATERIALES Y METODOS

La recolección de las semillas se efectuó en la Estación de Biología Tropical "Los Tuxtlas" en el Estado de Veracruz, México, perteneciente a la Universidad Nacional Autónoma de México. La vegetación y el ambiente del lugar son conocidos con relativo detalle (Gómez-Pompa y Del Amo, 1985).

Se escogieron tres especies del estrato medio y superior de la selva, que presentan tres niveles de abundancia: una especie muy abundante considerada como dominante del estrato alto: Nectandra ambigens (Blake) C.K.Allen (Lauraceae), una especie de abundancia intermedia del estrato medio y alto: Cymbopetalum baillonii R.E. Fries (Annonaceae) y una especie escasa del estrato medio: Couepia polyandra (H.B.K.) Rose (Rosaceae).

Los parámetros medidos fueron: longitud, anchura, grosor, pesos en fresco y seco, contenido en humedad de las semillas, así como el porcentaje y velocidad de germinación a temperatura constante y fluctuante. Para conocer la variabilidad intra e inter-individual de cada parámetro, cada semilla se individualizó para su estudio.

En el campo se localizaron tres árboles maduros de cada especie fructificando simultaneamente, dentro de un área homogénea de 5 ha. Los frutos maduros fueron recolectados al momento de la disemina-

ción de las semillas, durante los meses de junio a septiembre de 1986. Cada semilla fué despojada de los restos del fruto y lavada antes de asignarle su número correspondiente. Se eliminaron las defectuosas y parasitadas.

En los laboratorios de la Ciudad de México, se obtuvo el peso fresco después de estabilizar su contenido de humedad manteniéndolas a 75.5 % de humedad relativa durante cinco días. Se tomó una muestra al azar de 100 semillas por árbol para obtener el peso en seco y el contenido en humedad, para lo cual las semillas se desecaron durante 48 horas en un horno a 80º C. Debido al efecto destructivo de esta determinación, esta parte de la muestra no se empleó en pruebas de germinación.

Las semillas de cada árbol se dividieron en lotes de 200 semillas cada uno, para efectuar las pruebas de germinación en dos condiciones de temperatura diferente, empleando para ello dos cámaras de crecimiento con luz combinada (incandescente y fluorescente), 12 horas de fotoperiodo y humedad a saturación. Las temperaturas fueron en un caso 25º C constantes y en el otro una fluctuación de 25º a 30º C en 24 horas, para reflejar la estabilidad térmica del suelo de la selva intacta y la fluctuación que ocurre en los claros pequeños y las orillas (Vázquez-Yanes y Orozco-Segovia, 1982).

En las pruebas de germinación las semillas reposaron en un lecho de agar (1%) en agua destilada, en cajas de plástico transparente incoloro. Se determinó el tiempo transcurrido hasta la germinación de la primera semilla de cada árbol (tiempo de latencia) y la velocidad de germinación usando la ecuación de Kotowski (en Comê, 1978) y el porcentaje final de germinación.

Se utilizó la prueba estadística de "t" para comparar los valores morfológicos de árboles diferentes y la prueba de "semejanza entre porcentajes" para los datos de germinación. Para establecer el significado de la variabilidad de la respuesta germinativa, en relación con la variabilidad morfológica, se calcuraron los coeficientes de correlación (r) pertinentes.

RESULTADOS

En la tabla 1, se presentan los datos de los parámetros mofológicos. En *N. ambigens* , la prueba ("t") indica que las diferencias son significativas entre los árboles 1 y 2, 1 y 3. No lo son entre 2 y 3, para todos los valores.

En *C. baillonii* , hay diferencias significativas entre todos los valores, salvo el contenido de humedad, que es diferente entre los árboles 1 y 2, 2 y 3, pero no entre 1 y 3.

En *C. Polyandra*, hay diferencias significativas para todos los valores, salvo el grosor, que es diferente solo entre 1 y 2, 1 y 3.

Nectandra ambigens

	A	B	C	D	E	F
Arbol 1	2.31(0.15)	1.47(0.11)	1.41(0.10)	2.70(0.73)	1.25(0.42)	54.57(5.28)
Arbol 2	2.48(0.34)	1.62(0.12)	1.55(0.12)	3.68(0.95)	1.85(0.53)	49.94(3.71)
Arbol 3	2.45(0.30)	1.64(0.12)	1.57(0.11)	3.63(0.92)	1.80(0.50)	50.78(3.50)
Mínimo G.	1.45	1.20	1.15	1.21	0.33	44.92
Máximo G.	3.10	1.95	1.85	6.29	3.35	70.16
M. V. ind.	1.76	1.45	1.45	3.92	2.48	1.25
M. V. col.	2.14	1.62	1.61	5.17	8.41	1.56

Cymbopetallum baillonii

	A	B	C	D	E	F
Arbol 1	1.61(0.11)	0.92(0.06)	0.60(0.06)	0.67(0.06)	0.47(0.05)	33.76(3.43)
Arbol 2	1.42(0.13)	0.86(0.08)	0.49(0.06)	0.44(0.04)	0.30(0.03)	31.06(2.09)
Arbol 3	1.49(0.13)	0.94(0.08)	0.55(0.09)	0.47(0.04)	0.31(0.04)	33.58(3.84)
Mínimo G.	1.00	0.70	0.40	0.27	0.16	27.23
Máximo G.	1.80	1.10	0.80	0.77	0.52	46.78
M. V. ind.	1.51	1.39	1.70	1.96	2.21	1.56
M. V. Col.	1.80	1.57	2.00	2.84	3.24	1.72

Couepia polyandra

	A	B	C	D	E	F
Arbol 1	2.54(0.21)	1.28(0.09)	1.27(0.10)	2.74(0.43)	1.45(0.24)	46.94(1.55)
Arbol 2	2.93(0.29)	1.50(0.13)	1.41(0.10)	4.50(0.85)	2.47(0.49)	45.05(1.23)
Arbol 3	3.36(0.29)	1.38(0.11)	1.28(0.09)	4.26(0.72)	2.14(0.38)	49.70(2.62)
Mínimo G.	2.00	1.10	1.10	1.72	0.93	42.43
Máximo G.	3.90	2.00	1.65	6.70	3.71	61.36
M. V. ind.	1.54	1.54	1.45	2.34	2.48	1.25
M. V. col.	1.95	1.82	1.50	3.89	3.96	1.45

Tabla 1 .- Valores morfológicos obtenidos para los tres árboles de cada especie. Se indica (entre paréntesis)la Desviación Standard. Mínimo G. y Máximo G. son los valores extremos de cada parámetro en semillas que germinaron. M. V. ind. es la media de la magnitud de variación (fold variation)de los tres árboles. M. V. col. es la magnitud de la variación colectiva o del total de las semillas. A.- longitud, B.- anchura, C.- grosor, D.- peso fresco, E.- peso seco (ambos en gr), F.- contenido en humedad (%). Todas las longitudes en cm.

	Temperatura:	Constante			Fluctuante		
	Parámetro:	%	V.	TL.	%	V.	TL.
N. ambigens:	árbol						
	1--	98	87	26	92	75	21
	2--	98	45	77	90	83	23
	3--	90	103	23	90	37	69
C. baillonii:	árbol						
	1--	95	5	22	93	38	35
	2--	95	5	19	98	16	18
	3--	94	7	13	95	26	22
C. polyandra:	árbol						
	1--	-	-	-	64	5	17
	2--	-	-	-	46	11	17
	3--	-	-	-	29	10	21

Tabla 2.- Porcentaje de germinación final(%), velocidad de geminación a partir de la germinación de la primera semilla (V.) y tiempo de latencia antes de la germinación de la primera semilla (TL.), en condiciones de temperatura constante (25^{o}) y fluctuante (25^{o} - 35^{o} C).

La taba 2 contiene los resultados obtenidos en las pruebas de germinación. La comparación de porcentajes solo muestra diferen - cias significativas entre los árboles 1 y 3 de _C. polyandra_ a temperatura fluctuante; sin embargo, los resultados de velocidad de germinación y algunos de tiempo de latencia si difieren considerablemente en _N. ambigens_, sín que se den en un patrón claro. En el caso de _C. baillonii_, la fluctuación de temperatura retarda la germinación y reduce la velocidad a la que esta ocurre.

Los datos de _C. polyandra_ a temperatura constante se perdieron por un problema técnico cuando la germinación ocurría normalmente.

Los coeficientes de correlación, cuya magnitud fué de -0.5 a +0.03 no parecen indicar que exista una relación entre los valores de dimensiones y pesos de las semillas con su capacidad para germinar a diferente velocidad, por lo que no se incluyen aquí. Numerosos datos complementarios y cálculos tampoco se incluyen en este artículo (Puchet, 1986).

DISCUSION

En esencia, los resultados obtenidos indican que existe una considerable variación dentro y entre árboles de las tres especies, por lo que respecta a los parámetros morfológicos medidos. Esta variación no presenta relación con la germinación en dos condiciones diferentes de temperatura.

El contenido de humedad podría estar relacionado con el tiempo de latencia, dado el diferente grado de hidratación inicial que se observa en las semillas, pero se requeriría de un planteamiento experimental diferente para concluír algo al respecto. En un expe-

experimento posterior será aconsejable separar primero las semillas en categorías definidas de peso y tamaño y a partir de ellas realizar las pruebas de germinación para detectar si existe alguna correlación entre germinación, talla y peso no detectada aquí. Dicho experimento requeriría de un número inicial de semillas mucho mayor, para obtener una cantidad representativa y suficiente de cada categoría.

Al contrario de lo esperado inicialmente, el peso seco resultó ser el parámetro más variable, lo cual indica que las diferencias de talla y peso reflejan principalmente variaciones en el volumen de las reservas, del embrión y/o el grosor de los tegumentos, amplificadas por el contenido en humedad. Las plántulas resultantes de la germinación de estas semillas deben de contar con recursos iniciales distintos para comenzar a crecer. Esto puede determinar que se originen plántulas de diferente talla y posibilidades de sobrevivencia, dependiendo esto último de las condiciones del microambiente al que sean transportadas por los diseminadores. Posiblemente esta variabilidad incremente las posibilidades del establecimiento en un ambiente heterogeneo (Janzen, 1977b).

En terminos generales, la variación de los pesos de las semillas dentro de un mismo individuo puede interpretarse como una adaptación que da lugar a la producción de una lluvia de semillas más hómogénea durante la dispersión, ya que las semillas de diferente peso teoricamente podrían recorrer distancias distintas, en comparación con lo que ocurriría con semillas de pesos más constantes (Janzen, 1977a, 1978).

Por último, no puede descartarse la posibilidad de que la variabilidad esté relacionada con algún mecanismo de escape a la predación, aunque también es muy posible que la variabilidad observada solo sea el reflejo de las diferentes condiciones de desarrollo de las semillas en la copa de los árboles y en los diferentes microambientes y que en la realidad no tenga ningún valor adaptativo.

La germinación de N. ambigens no se produce simultaneamente sino en forma escalonada, lo que puede considerarse como un polimorfismo germinativo no asociado a un heteromorfismo de talla de las semillas (Silvertown, 1984).

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BIBLIOGRAFIA

Comê, D. 1968. Problèmes de terminologíe posés par la germination et ses obstacles. Bull. Soc. Franç. Physiol. Végét. 14: 3-9.

Foster, S. A. 1986. On the adaptative value of large seeds for tropical moist forest trees: A review and Synthesis. Bot. Rev. 52: 260-299.

Gómez-Pompa, A. y S. Del Amo (Editores). 1985. Investigaciones sobre la regeneración de selvas en regiones cálido-húmedas de México. Vol. 2. Editorial Alhambra Mexicana, México D. F. 1-393.

Janzen, D. H. 1977a. Variation in seed size within a crop of a Costa Rican _Mucuna andreana_ (Leguminosae). Amer. J. Bot. 64: 347-349.

____________ 1977b. Variation in seed weight in a Costa Rican _Cassia grandis_ (Leguminosae). Trop. Ecol. 18: 177-186.

____________ 1978. Inter and intra-crop variation in seeds weight of Costa Rican _Ateleia herbert smithii_ Pitt. (Leguminosae). Brenesia 14/15: 311-323.

Ng, F. S. P. 1980. Germination ecology of Malaysian woody plants. Malay. Forester 43: 406-437.

Puchet, C. E. 1986. Ecofisiología de la germinación de semillas de algunos árboles de la vegetación madura de la selva de "Los Tuxtlas", Veracruz, México. Tesis Profesional, Facultad de Ciencias, UNAM. 1-106.

Roberts, E. H. 1973. Predicting the storage life of seeds. Seed Sci. & Technol. 1: 499-514.

Silvertown, J. W. 1984. Phenotypic variety in seed germination behavior: The ontogeny and evolution of somatic polymorphism in seeds. Am. Nat. 124: 1-16.

Vázquez-Yanes, C. y A. Orozco Segovia 1982. Seed germination of a tropical rain forest tree (_Heliocarpus donnell smithii_) in response to diurnal fluctuations of temperature. Physiol. Plant. 56: 295-298.

____________________________ 1984. Ecophysiology of seed germination in the tropical humid forest of the world: a review. En: Mooney, H. A. _et al_ (Editores). Physiological Ecology of Plants from the wet tropics. Dr. W. Junk, The Hague. 37-50.

Venable, D. L. 1985. The evolutionary ecology of seed heteromorphism. Am. Nat. 126: 577-595.

A CONTRIBUTION TO THE TAXONOMY OF BORAGINACEAE

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ABSTRACT

Macro-and micro-floral characters of 34 taxa of Boraginaceae were investigated. The data in this work could be both diagnostic and interpretative. An interesting correlation was found to exist between the lobing of the ovary on one hand and the style insertion, the ovule attachment and the fruit type on the other hand. The vascular supply of the perianth leaves and the stamens showed no serious fluctuations. That of the gynoecium showed marked plasticity expressed by amplification through splitting, reduction through missing or fusion, and by diversed feeding of the styles by vascular supply from different origin. Twelve of the recorded characters were chosen as evolutionary dicta for the family, and the discussion of all led to a schematic presentation of presumed intra-affinities. Among the latter, it has been suggested that *Heliotropium* represents an evolutionary stock from which all other taxa can radiate; and *H. digynum* with its hexamerous flower may be the core of this genus. Previous opinions on the micro-evolution in the Boraginaceae have been discussed in view of our data.

INTRODUCTION

Phylogenetic treatments of Boraginaceae were rather diverse and an extreme was the isolation by Hutchinson (1948) of a number of its members under an additional family the Ehretiaceae. Impressed by their habit he treated both families as radiating from two evolutionary stems; Boraginaceae from Herbaceae and Ehretiaceae from Lignosae.

Several taxonomists (e.g. Hallier 1912. Bessey 1915. Brand 1921. Wettstein 1935. Johnston 1923-49. Lawrence 1963. Chopra 1971. Takhtajan 1980: and others) have discussed the intra-relations of Boraginaceae taxa as well as its affinity to other families. These discussions led to more or less empirical view-points. Meanwhile the taxonomic treatment of the family main sub-divisions might have received less arbitrary arguments: and the Englerian 4 sub-families and 6 tribes have shown themselves to be the classically acceptable major sub-taxa. The limitation of these ranks relied entirely upon the enumerated characters: (i) aspect of the ovary. topography and aspect of the style. and (iii) the fruit type. Coupled with other floral characters all were assertive where used as diagnostic. However. the discipline of floral morphology as an approach to taxonomy began as early as 1871 by Van Tieghem who also raised an attention to the marked variations of styles and stigmas within Heliotropioideae. More recently the same approach as applied to Boraginaceae can be exemplified by the work of Hutchinson (1969). Fabre & Nicoli (1974) Joshi (1975. 76) Di Fulvio (1978). Schmida (1978) and Khalifa & Hamed (1982).

Here. it would be space-consumption to raise the significance of such an approach although it yielded data that made possible. in many places. rational comprehensions to puzzling matters as character plasticity and correlation. the nature of extra-floral organs. the magnitude of attributes: and the like: thus settling dubious cases in taxonomy and phylogeny. Convinced by this we here are investigating 33 spp. and one variety for more contribution to the taxonomy of Boraginaceae.

MATERIALS AND METHODS

Flower buds of 33 spp. and one variety in 18 genera were studied. The materials were fixed in FAA. embedded in wax. stained in safranin-light green combination and serially cross sectioned at 8-10m according to the conventional methods. The observations were mostly condensed in tabular form. The drawings were deliberately avoided for our observations showed no essential deviation from those previously recorded by other workers. In this paper the taxa in any place are dealt with in the sense of Engler and Prantl. Table 1. shows the collection data.

TABLE 1. COLLECTION DATA

SUB-FAMILY	TRIBE	SPECIES
I. Ehretioideae		1. *Ehretia buxifolia* Roxb.*
II. Cordioideae		2. *Cordia myxa* L.*
		3. *C. sebestena* L.*
		4. *C. tremula* Griseb.*
III. Heliotropioideae		5. *Heliotropium arabinense* Fres.
		6. *H bacciferum* Forsk.**
		7. *H. digynum* (Forsk.) Asch. ex C. Christens
		8. *H. europaeum* L.
		9. *H. supinum* L.**
		10. *H.* sp. 1**
		11. *H.* sp. 2*
IV. Boraginoideae	Cynoglosseae	12. *Cynoglossum officinale* L.*
		13. *Trichodesma africanum* (L.) R.Br
	Eritricheae	14. *Echiochilon fruticosum* Desf.
		15. *Lappula deflexa* (lehm.) Grache
	Anchuseae	16. *Symphytum tuberosum* L.**
		17. *Borago officinalis* L.***
		18. *B. orientalis* L.***
		19. *Anchusa officinalis* L.***
		20. *A. aegyptiaca* (L.) DC.
		21. *A. arvensis* (L.) M.B.**
		22. *Alkanna tinctoria* (L.) Tausch.
		22. A. t. var. incana Boiss.
		23. *Gastroctyle hispida* (Forsk.) Bunge
		24. *Lycopsis arvensis* L.***
	Lithospermeae	25. *Lithospermum officinale* L.**
		26. *Arnebia hispidissima* (Lehm.) DC.*
		27. *Moltikiopsis ciliata* (Forsk.) Johns
	Echieae	28. *Echium rosulatum***
		29. *E. creticum* L.**
		30. *E. longifolium* Del.
		31. *E. sericeum* Vahl
	Cerintheae	32. *Cerinthe minor* L.**
		33. *C. glabra* Mill**

Non-asterisked spp. are among the Egyptian flora

* Horticultural spp. in the Faculty Gardens

** Loaned as fixed flower buds

*** Loaned as seeds and raised under the mesophytic conditions

OBSERVATIONS AND DISCUSSION

BILATERAL SYMMETRY

The bilateral symmetry of the corolla in some spp. besides its marked expression in certain Echium spp. promoted Lawrence (1937) to favour its adoption to the tribal limitation. However an earlier view by Johnston (1923-49) restricted it to specific limitation on account of its occurrence in other genera not closely related to Echium. We here support the latter opinion since Echiochilon fruticosm (Eritricheae) is highly zygomorphic.

COROLLA APPENDAGES (TABLE 2)

Puri (1951) reported on their occurrence in a number of families including our's. Here the appendages at the corolla throat (also termed petaloid scales, corona) occur in 13 taxa all in Boraginoideae. Lawrence (1937) gave them value for generic limitation. However their nature would be discussed elsewhere in this paper.

LOBING OF THE OVARY (TABLE 3)

Ovary entire (unlobed) in Ehretia buxifolia and the 3 Cordia spp. Slightly lobed in 8 taxa. Prominently lobed in 5 taxa. Lobed and winged in 7 taxa (with wing-like parenchymatous tissue between the carpels). Lobed and ringed in 10 taxa (with ring-like parenchymatous tissue that persists between the nutlets).

INSERTION OF THE STYLE (TABLE 3)

AND THE NATURE OF THE GYNOBASE

The style is terminal in Ehretia buxifolia, the 3 Cordia spp. and the 7 Heliotropium spp; all with either entire or slightly lobed ovaries. It is gynobasic in 23 taxa with prominently lobed overies. Thus we may refer to a correlation between the lobing of the ovary and the topography of the style: the former also determines the fruit type (see next item). However it is observed that the deeper the constriction in the ovary is the lower will be the attachment of the style to the carpels and the more is the tendency towards nutlet formation.

The term "gynobase" has not yet been fully understood although its use dates back in earlier literature (Lawrence 1937). As to its nature Moore (1936 b), considered it as fused staminodes in certain Leguminosae, and as carpellodes in many Apocynaceae. In certain Boraginaceae (Mertensia) the same author (1936a) interpreted it as carpellodes. Still in Boraginaceae Joshi (1957) showed that it consists of parenchymatous tissue continuous with the receptacle, and concluded that it can be designated, in part, as placenta. The conclusion of Joshi is in accord with that of Lawrence: that the gynobase is of placental nature since it shares in the body to which the ovules are attached. The present observations show that in taxa with gynobasic

TABLE 2. MACROMORPHOLOGY OF CALYX AND COROLLA

	CALYX		COROLLA					
	NUMBER	TEXTURE	NUMBER	TEXTURE	LIMB	BASE(PP)	THROAT(SC)	SYMMETRY
1. Alkanna tinctoria	5	P	5	G	0	10	+	+
2. A. t. var. incana	5	RH	5	G	0	10	+	+
3. Anchusa aegyptiaca	5	DH	5	G	0	-	+	+
4. A. arvensis	5	RH	5	G	0	-	+	+
5. A. officinalis	5	H	5	G	0	-	+	+
6. Arnebia hispidissima	5	HI	5	G	0	10	-	+
7. Borago officinalis	5	DH	5	G	A	-	+	+
8. B. orientalis	5	R	5	G	A	-	+	+
9. Cerinthe glabra	5	H	5	G	A	10	-	+
10. C. minor	5	H	5	G	A	10	-	+
11. Cordia myxa	6	G	5/6	G	A	5	-	+
12. C. sebestena	2-5	L	12	G	A	-	-	+
13. C. tremula	5/6	L	5/6	G	0	5	-	+
14. Cynoglossum officinale	5	R	5	G	A/0	10	+	+
15. Echiochilon fruticosum	5	RD	5	H	A	-	-	-
16. Echium creticum	5	G	5	H	A	-	-	-
17. E. longifolium	5	H	5	G	A	-	-	-
18. E. rosulatum	5	H	5	H	A	-	-	-
19. E. sericeum	5	H	5	G	0	-	-	-
20. Ehretia buxifolia	4	G	5	H	0	-	+	+
21. Gastroctyle hispida	5	H	5	G	0	-	-	+
22. Heliotropium arabinense	5	R	5	H	A/0	-	-	+
23. H. bacciferum	5	R	5	H	0	-	-	+
24. H. digynum	5/6	R	5/6	G	RE	-	-	+
25. H. europaeum	5	DH	5	H	0	-	-	+
26. H. supinum	5	R	5	H	0	-	-	+
27. H. sp. 1	5	G	5	G	A	-	-	+
28. H. sp. 2	4/5	H	4/5	H	0	-	-	+
29. Lappula deflexa	5	H	5	G	0	-	+	+
30. Lithospermum officinale	5	H	5	G	W	10	+	+
31. Lycopsis arvensis	5	H	5	G	0	-	+	+
32. Moltikiopsis ciliata	5	HS	5	H	A	-	-	+
33. Symphytum tuberosum	5	H	5	G	RE	5	+	+
34. Trichodesma africanum	5	H	5	G	A	-	-	+

A. ACUTE; DH. DENSELY HAIRY; G. GLABROUS; H. HAIRY; HI. HISPID STRIGOSE; L. LEATHERY; O. OBTUSE; P. PUBESCENT; PP. PARENCHYMATOUS PROTUBERANCE; R. RUGOSE; RD. ROUGH DOTTED; RE. REFLEXED; RH. ROUGH HAIRY; SC. SCALES.

styles the ring structure (see previous item) appears likely to be a parenchymatous continuation of the receptacular core thus justifying a composite nature to the gynobase. This structure is built at its base from receptacular tissue and at its sides and top from the inrolled carpellary leaves.

Another correlation can be said to exist between the style insertion and the ovule attachment. In the spp. with terminal styles the ovules become attached at a relatively high level appearing pendulous. As the stylar attachment becomes progressively lowered the ovule attachment is likewise lowered and a climax is reached in the spp. with basal styles where the ovules appear basal, erect and long funicled. Structurally this latter correlation may support the view that the basal part of the style adnate to the ring structure is almost related to placental tissue. Moreover this positive correlation can be signified in Boraginaceae if we think about a functional adaptation of an ovule behaving as a satellite to the style to cut short the road to a successful copulation.

THE FRUIT (TABLE 3)

Nutlet in 22 taxa where the carpels separate from each other with the style inserted in between. Simple nutlet (druplet) in the 7 Heliotropium spp. and in Trichodesma africanum. Drupe in Ehretia buxifolia and the 3 Cordia spp.

Several taxonomists adopted the fruit type as a lead to the sub-families limitation. Thus Cordioideae had been assumed to be primitive on the bases of their entire ovaries maturing into drupes. Ehretioideae and Heliotropioideae with either entire or slightly lobed ovaries have druplets (simple nutlets) and were considered more advanced. Stepping like-wise we may rank Boraginoideae higher for the well developed 4 nutlets its members have in response to the deep lobing of the ovary. However it may be worthy to point out that: (i) Cynoglossum officinale with typical nutlets and Trichodesma africanum with simple nutlets are retained in one tribe Cynoglosseae. (ii) The typical drupe of Ehretia buxifolia stamps it primitive in Ehretioideae although the latter includes other spp. with simple nutlets. (iii) The Heliotropioideae spp. show various degrees of carpellary lobing: thus Heliotropium may be localized between the less advanced Cordioideae (entire ovaries) and the more advanced Boraginoideae (deeply lobed ovaries).

External evidence in favour of the significance of the fruit type at various levels is adopted from Lawrence (1937), Riedl (1967) Fabre & Nicoli (1974) and Schmida (1978). Lawrence (1937) showed that Boraginoideae includes both simple and typical nutlets and Lithospermeae as well as Eritricheae contain some spp. with simple nutlets although winged and ringed types do occur. Fabre & Nicoli (1974) have found that the external morphology of the achene in certain Boraginaceae is of a considerable weight in generic and specific limitation. Earlier to that Riedl (1967) followed the fruit type to separate Paracaryum (with incurved wings) and Mattiastrum (with flattened

TABLE 3. MACROMORPHOLOGY OF ANDROECIUM. GYNOECIUM AND FRUIT

		STAMENS		GYNOECIUM			FRUIT	
		NUMBER	ADNATION	ASPECT	STYLE	STIGMA	TYPE	NO. OF D.F.U.
1.	Alkanna tinctoria	5	1/4T	L.W	B	S	N	2.4
2.	A. t. var. incana	5	2/3T	L.W	B	S	N	1*
3.	Anchusa aegyptiaca	5	1/2T	L	B	2L	N	4
4.	A. arvensis	5	V	L	B	2L	N	4U
5.	A. officinalis	5	V	L.W	B	+F	N	3
6.	Arnebia hispidissima	5	AT	L.W	B	2L	N	4
7.	Borago officinalis	5	AT	L	B	S	N	4
8.	B. orientalis	5	AT	L.W	B	S	N	4U
9.	Cerinthe glabra	5	1/2T	L.W	B	S	N	4
10.	C. minor	5	1/2T	L.W	B	+2F	N	4
11.	Cordia myxa	6	AT	UL	TE	4F	D	S
12.	C. sebestena	13	AT	UL	TE	4F	D	S
13.	C. tremula	5.6	1/3T	UL	TE	4F	D	S
14.	Cynoglossum officinale	5	1/2T	L.R	B	S	N	2
15.	Echiochilon fruticosum	5	1/2T	L.R	B	2F	N	4
16.	Echium creticum	5	1/2T	L.R	B	2FI	N	4
17.	E. longifolium	5	1/2T	L.R	B	2FI	N	4
18.	E. rosulatum	5	1/2T	L.R	B	2FI	N	4
19.	E. sericeum	5	1/3T	L.R	B	2FI	N	4
20.	Ehretia buxifolia	5	1/3T	UL	TE	2F	D	S
21.	Gastroctyle hispida	5	1/2T	L.R	B	S	N	2
22.	Heliotropium arabinense	5	1/2T	SL	TE	S	SN	4.2
23.	H. bacciferum	5	1/2T	SL	TE	S	SN	4
24.	H. digynum	5.6	3/4T	SL	TE	2L	SN	4
25.	H. europaeum	5	3/4T	SL	TE	S	SN	4
26.	H. supinum	5	1/3T	SL	TE	S	SN	1*
27.	H. sp. 1	5	1/3T	SL	TE	S	SN	4
28.	H. sp. 2	4.5	1/3T	SL	TE	S	SN	4
29.	Lappula deflexa	5	1/2T	L.R	B	2FI	N	4
30.	Lithospermum officinale	5	1/3T	L.R	B	S	N	3
31.	Lycopsis arvensis	5	2/3T	L	B	2L	N	4
32.	Moltikiopsis ciliata	5	3/4T	L	B	+2FI	N	4
33.	Symphytum tuberosum	5	3/4T	L.R	B	S	N	4
34.	Trichodesma africanum	5	3/4T	SL	+B	S	SN	4

* NUTLETS REDUCED TO ONE BY ABORTION

AT. ALONG THE LENGTH OF THE COROLLA TUBE: B. BASAL: D. DRUPE. D.F.U. DEVELOPING FRUIT UNITS. F. FORKED FI. FID : L. LOBED: N. NUTLET: R. RINGED. S. SINGLE. SL. SLIGHTLY LOBED: SN. SIMPLE NUTLET: T. COROLLA TUBE: TE. TERMINAL. U. UNEQUAL: UL. UNLOBED: V. VARIABLE W. WINGED.

wings) Contrary to that Schmida (1978) stated that such separation which is based on this character alone is hardly useful on account of the occurrence of forms with incurved and flattened fruit wings in the different spp. of the same genus viz. Paracaryum intermedium and P. boisseri.

SEPAL VASCULATURE (TABLE 4)

The sepal is supplied with 3 traces; one median and two lateral. The traces behave differently as follows:

1. All differentiate independant in the receptacle from the central stele (Cordia tremula).
2. Median traces branch in the sepals giving the laterals.
3. Median traces arise from a lower set of 5 bundles; and the lateral traces from an upper set of other 5 bundles. Each of the latter branches into two to two adjacent sepals (Heliotropium bacciferum).

PETAL VASCULATURE (TABLE 4)

Amplification in the petal supply is recorded when the petal laterals differentiate from the corolla tube at points just below the separation of the staminal filaments. This observation embodies the 6-merous type of Heliotropium digynum, the 4-merous type of H. sp. 2 and in forms with variable numbers of corolla lobes (Cordia sebestena).

VASCULATURE OF THE COROLLA APENDAGES (TABLE 4)

Two types of such appendages are met with. Those at the base of the corolla tube termed parenchymatous "protuberances", which are not vascularized; and those occurring at the corolla throat either vascularized or not. Our discussion is focussed on those at the throat and 3 types of vasculature are recorded:

1. Appendages without vascular supply (Alkanna tinctoria var. incana, Anchusa arvensis).
2. Appendages with one vascular trace (Anchusa officinalis Lithospermum officinale, Symphytum tuberosum).
3. Appendages with 2 vascular traces (Alkanna tinctoria, Anchusa aegyptiaca, 2 Borago spp., Cynoglossum officinale, Gastroctyle hispida, Lappula deflexa, Lycopsis arvensis).

In this type the appendages are relatively expanded almost at the centre and the traces fuse towards the terminal narrow portion.

TABLE 4. VASCULARIZATION OF SEPALS, PETAL APPENDAGES AND STAMENS

	SEPAL TRACES	APPENDAGE TRACES	SEPARATION OF STAMINAL TRACES
1. alkanna tinctoria, Type (1)	5	2F	B TH
1. ----------------- , Type (2)	5	2F	B TH
2. ----------------- var. incana	5	NV	B TH
3. Anchusa aegyptiaca	5	2F	B TH
4. A. arvensis	5	NV	TH
5. A. officinalis	5	1	B TH
6. Arnebia hispidissima	5	-	B TH
7. Borago officinalis	5	2F	B TH
8. B. orientalis	5	2F	B TH
9. Cerinthe glabra	5	-	B TH
10. C. minor	5	-	B TH
11. Cordia myxa	N	-	B TH
12. C. sebestena	N	-	M T
13. C. tremula Type (1)	15	-	TH
13. ------------ Type (2)	15	-	TH
14. Cynoglossum officinale	5	2F	B TH
15. Echiochilon fruticosum	5	-	TH
16. Echium creticum	5	-	B TH
17. E. longifolium	5	-	B TH
18. E. rosulatum	5	-	TH
19. E. sericeum	5	-	B TH
20. Ehretia buxifolia	N	-	B TH
21. Gastroctyle hispida	5	2F	B TH
22. Heliotropium arabinense	5	-	M T
23. H. bacciferum	10	-	M T
24. H. digynum	5,6	-	TH
25. H. europaeum	5	-	TH
26. H. supinum	5	-	1/3 T
27. H. sp. (1)	5	-	1/3 T
28. H. sp. (2)	4,5	-	M T
29. Lappula deflexa	5	2F	B T
30. Lithospermum officinale	5	1	B T
31. Lycopsis arvensis	5	2F	B TH
32. Moltikiopsis ciliata	5	-	M T
33. Symphytum tuberosum	5	1	M T
34. Trichodesma africanum	5	-	M T

-, APPENDAGE ABSENT; BT, BASE OF COROLLA TUBE; B TH, BASE OF COROLLA THROAT; F, FUSED; MT, MIDDLE OF COROLLA TUBE; N, NUMEROUS; NV, NON-VASCULARIZED; T, COROLLA TUBE; TH, COROLLA THROAT.

As to their nature Schleiden (1849) identified a scale as merely an elaborated fold representing dependant appendage of the foliar organ developing originally simple and flat. Gurke (in Engler & Prantl 1897) looked to the scales as a ring of abortive stamens. Lawrence (1937) regardless of its topography, considered the scale to be a fold of the corolla tissue. Joshi (1975) did not comment on their nature although he gave them a generic value in Boraginaceae.

The variability of vasculature as recorded in this work would encourage the refutation of Gurke's staminal concept about the nature of the scales: a refutation further confirmed by their vascular supply which comes from the petal traces. In accordance with Lawrence we would assert upon the corollary folding nature of the scales at the corolla throat. We may add: the degree of folding would determine the number of traces: either one in less expanded or 2 in relatively expanded scales.

STAMEN VASCULATURE (TABLE 4)

Five alternate staminal traces diverge close to and above the petal traces, tress-pass the corolla tube and eventually enter the filaments when the latter become free. The separation of the stamens from the corolla tube takes place at different levels in the different taxa.

GYNOECIUM VASCULATURE (TABLE 5)

In all taxa the ovary is 2-carpelled, 4-loculed with a single ovule in each. Normally the carpel is a 3-trace organ. However the following vascularization patterns were recorded:

1. Dorsal bundles: Absent altogether in Cordia tremula, Ehretia buxifolia and Gastroctyle hispida. In Alkanna tinctoria (Type 1) only one bundle was recorded: and in this sp. a reduction of half of the ovary resulted in the formation of 2 simple nutlets. In Heliotropium spp. (except H. sp. 2) 4 bundles were recorded. The remainder taxa had 2 bundles each: one for each carpel.
   As to their behaviour:

   Type (a): Normal (unchanged). In 22 taxa: where each carpel has its dorsal which passes inward and upward to the top of the nutlet, then passes inward to run into the style. The 2 dorsals give laterals to supply the periphery of the carpels.

   Type (b): Fused. In Heliotropium arabinense, H. europaeum and H. supinum 4 dorsals are present, 2 to each carpel Each pair fusses at the top of the ovary to run into the style.

   Type (c): Splitted. In Cordia sebestena where the 2 dorsals of the 2 carpels split into 4 before entering in the style.

   Type (d): Fading. In Heliotropium digynum and H. sp. 1; where 4 dorsals are ill-developed and fade out near the summit of the ovary. The stylar supply comes from the 4 septal bundles. In Heliotropium sp. 2 each carpel

is supplied with one dorsal which fades at the base of the ovary.

2. Ventral bundles: Four were observed to represent the ovular supply. However only 2 were recorded in Type 2 of Alkanna tinctoria and in Ehretia buxifolia where the ovary is 2-loculed, 2-ovuled. As to their behaviour Lawrence (1937) pointed out that one would expect the occurrence of 4 ventrals in the lowest forms of the family; each giving one ovular trace, and they all would continue to the top of the ovary. However, the following behaviour has been recorded.

   Type (a): Normal in 29 taxa wher the 4 ventrals give the ovular supply then fade at once. This is common in Boraginoideae and confirms Lawrence (1937). However similar behaviour has been on record in the other sub-families.

   Type (b): Splitted. In Cordia myxa the number is increased through splitting of the 4 ventrals into 6 traces; 4 of the latter supply the ovules then extend into the style. In Ehretia buxifolia the 2 ventrals split into 4 traces to supply the ovules; then fuse to form the stylar supply. In this connection Lawrence (1937) mentioned that in Cordia cumingiana and Ehretia viscosa the fused bundles continue to the top of the ovary and fuse with the laterals. In cordia alliodora and Ehretia canariensis the ventral bundles fade out below the top of the ovary. Thus two evolutionary trends had been assumed to occur in sub-families Cordioideae and Ehretioideae. The same author added that the cases in which the ventral bundles continue to the top of the ovary (after supplying the ovules) would be expected to represent the lowest forms of the Boraginaceae. More recently Joshi (1976) recorded similar behaviour of ventrals in Cordia dichotoma, C. gharal and Ehretia aspera.

   Type (c): Fused. In Cordia tremula and Gastroctyle hispida in which, after supplying the ovules, the 4 ventrals fuse into 2 to feed the style. The occurrence in Gastroctyle hispida of such behaviour is not unexpected since the carpellary dorsals are wanting and this might be a primitive case among the Boraginoideae. Meanwhile its occurrence in Heliotropium spp. might be attributed to the reduction of the 4 dorsals to 2 besides the missing of the 4 septals in other spp. of this genus. In Heliotropium sp. 2 the continuation of the ventrals after supplying the ovules might be a transitional case within this genus.

THE STYLAR SUPPLY (TABLE 5)

1. Derived from the 2 carpellary dorsals (in 24 taxa).
2. Derived from the 2 carpellary ventrals in Cordia tremula, Ehretia buxifolia and Gastroctyle hispida; where the 2 ventrals are a fusion product of 4 bundles.
3. Derived from one ventral and one dorsal. In Alkanna tinctoria (Type 1) having 2 locules with one ovule in each. The dorsal trace is one and the ventral traces are 2. The latter traces branch beyond the ovular supply and move inward to enter a columnar tissue. Then a trace from this tissue opposite the dorsal and together with it forms the stylar supply.

TABLE 5. VASCULARIZATION OF THE GYNOECIUM

	DORSAL BUNDLES(D.B.)	VENTRAL BUNDLES(V.B.)	SEPTAL BUNDLES(S.B.)	BEHAVIOUR OF D.B.	BEHAVIOUR OF V.B.	STYLAR SUPPLY	COLUMNAR TISSUE	NECTARY DISC
1. Alkanna tinctoria Type 1	1	2	W	N	F	IV.B+1D.B	+	-
1. ——————— Type 2	2	4	2	N	N	2D.B	+	-
2. ——————— var. incana	2	4	W	N	N	2D.B	+	-
3. Anchusa aegyptiaca	2	4	W	N	N	2D.B	-	+
4. A. arvensis	2	4	W	N	N	2D.B	+	+
5. A. officinalis	2	4	W	N	N	2D.B	+	+
6. Arnebia hispidissima	2	4	W	N	N	2D.B	+	+
7. Borago officinalis	2	4	W	N	N	2D.B	+	+
8. B. orientalis	2	4	W	N	N	2D.B	+	+
9. Cerinthe glabra	2	4	2	N	N	2D.B+2S.B	-	+
10. C. minor	2	4	W	N	N	2D.B	+	+
11. Cordia myxa	2	4	W	FA	SP	4V.B	+	+
12. C. sebestena	2	4	2	SP	N	4D.B	+	+
13. C. tremula Type 1	W	4	W	W	F	2V.B	+	+
14. ————— Type 2	W	4	W	W	F	2V.B	+	+
15. Cynoglossum officinale	2	4	W	N	N	2D.B	+	+
16. Echiochilon fruticosum	2	4	W	N	N	2D.B	+	-
17. Echium creticum	2	4	W	N	N	2D.B	+	-
18. E. longifolium	2	4	W	N	N	2D.B	-	-
19. E. rosulatum	2	4	W	N	N	2D.B	+	-
20. E. sericeum	2	4	W	N	N	2D.B	+	+
21. Ehretia buxifolia	W	2	W	W	SP	4V.B	+	+
22. Gastroctyle hispida	W	4	W	W	F	2V.B	+	-
23. Heliotropium arabinense	4	4	4	F	N	2D.B	-	+
24. H. bacciferum	4	4	4	FA	N	4S.B	-	+
25. H. digynum	4	4	4	FA	N	4S.B	-	+
26. H. europaeum	4	4	4	F	N	2D.B	+	-
27. H. supinum	4	4	4	F	N	2D.B	+	+
28. H. sp. 1	4	4	4	FA	N	4S.B	+	-
29. H. sp. 2	2	4	W	FA	F	4V.B	-	-
30. Lappula deflexa	2	4	W	N	N	2D.B	-	-
31. Lithospermum officinale	2	4	W	N	N	2D.B	-	-
32. Lycopsis arvensis	2	4	W	N	N	2D.B	+	-
33. Moltikiopsis ciliata	2	4	W	N	N	2D.B	+	-
34. Symphytum tuberosum	2	4	W	N	N	2D.B	-	-
35. Trichodesma africanum	2	4	W	N	N	2D.B	+	-

-, ABSENT; F, FUSED; FA, FADING; N, NORMAL; +, PRESENT; SP, SPLITTING; W, WANTING.

THE COLUMNAR TISSUE (TABLE 5)

Present in 24 taxa. It is an extension of the pith from the receptacle upwards to the level where the carpellary laterals differentiate.

THE NECTARY DISC (TABLE 5)

Well developed in 18 taxa. In Heliotropioideae it is represented by the swollen bases of the ovaries. As to its nature the disc may be receptacular or carpellary depending on the behaviour of the carpellary dorsals.

1. Receptacular: Here the dorsals differentiate above the disc structure (Cordia tremula and Ehretia buxifolia).
2. Carpellary: When the dorsals differentiate below the disc (Anchusa spp.. Arnebia hispidissima, Borago spp.. Cerinthe spp.. Cynoglossum officinale, Heliotropium arabinense, and H. bacciferum). In other taxa (Cordia myxa, C. sebestena, Echium sericeum, Heliotropium digynum and H. supinum) we could not rule out its nature and such cases might be inbetween.

CONCLUDING REMARKS

The subsequent remarks represent a cumulative consideration of the floral characters that might be significant to the taxonomy of Boraginaceae: both diagnostic and interpretative.

1. NUMBER OF THE PERIANTH LEAVES

Multi-directional relations inside a family may be comprehended when the ancestor is postulated to have a flower with inconsistent number of perianth leaves. In general 6-merous flowers show an inherent plasticity when other types are to be derived. In Boraginaceae sensu lato pentamery is the rule. However 6-merous flowers have been recorded in certain spp. of Cordia Ehretia and Heliotropium. In the latter genus 4-mery occur as well.

Primitive forms of Boraginaceae have long been accepted to be the Cordioideae and the Ehretioideae. In both 5-mery is not the rule. Here it could be suggested that Heliotropium digynum may be related to the 6-merous taxa of both sub-families. Meanwhile 4-mery in certain spp. of this genus may be derived from 5-merous flowers through the loss of one set as an evolutionay trend.

2. THE COROLLA APPENDAGES

Our observations show that, unlike those on the base, the appendages on the throat are apparently of more taxonomic significance. The basal scales, if any, could be considered as mere superficial folds of the corolla tissue since they are always not vascularized. Meanwhile vascularization (when present) of the appendages on the throat is assumed to be correlated

with folding of the corolla tissue and the number of vascular bundles in each is determined by the degree of their expansion.

3. LOBING OF THE OVARY AND THE FRUIT TYPE

The lobing of the ovary determines nutlet formation and it is primarily on this that the sub-families have been given their relative position. A primitive case is assumed to be in Cordia spp. and in Ehretia buxifolia since the carpels are entire and mature into a drupe. In other taxa the moderate lobing leads to the formation of simple nutlets (druplets); and full lobing leads to the more advanced typical nutlets characteristic of the family. The progressive lobing starts from slight to winged to the more advanced ringed form. In this connection a transitional aspect is observed in the 7 Heliotropium spp. studied; and this together with floral symmetry may substantiate an intermediate evolutionary status of this genus.

4. STYLE INSERTION AND OVULE ATTACHMENT

It has been observed that the deeper the furrowing into the sides of the carpels is the lower is the attachment of the style. Slightly furrowed ovaries (Cordia spp., Ehretia buxifolia and Heliotropium spp.) have terminal (or lateral) styles. In some taxa deep furrowing results in entire separation of the style to be borne on the gynobase. Likewise; the ovule attachment seems to be affected by the style insertion; appearing apical with terminal styles and basal with gynobasic styles.

5. STIGMA

In most systems the stigmatic modification is the lead character to separate Heliotropiodeae and Ehretioideae. Evolutionary the dictum "from many to few" would make the single (entire) stigma an advance over the lobed, fid and forked forms. In the present study most taxa of sub-family Boraginoideae have the single stigma. Within Heliotropioideae, Heliotropium digynum is likely representing a less advanced case in this genus for its bilobed stigma.

6. CALYX, COROLLA AND ANDROECIUM VASCULATURE

The 5-merous flower represents a common pattern with 3-trace sepal, one trace petal and one trace stamen. In all cases the stamens are fused with the petals to a considerable distance. This plan is not basically changed on the occasional occurrence of 4-merous or 6-merous types. In the two latter cases it was only the number of vascular traces that was either decreased to 4 or increased to 6.

7. GYNOECIUM VASCULATURE

Following the departure of the stamen traces almost all the remaining vascular tissue incorporates in the supply of the carpels and their adherent structures. Various patterns of vasculature of the ovary, the ovules and the styles have been observed, but the most significant of all are, pherhaps,

those of the styles. In general, the diversity in the number and manner of feeding by the dorsal, ventral, septal and carpellary wall bundles can refer to some taxonomic relationships or evolutionary trends. The latter seem likely to take place within each taxonomic group down to the generic level as in Heliotropium. However, the main differences in gynoecium vasculature are demonstrated by variation in the following characters:

a) Missing of dorsal bundles or crpellary wall bundles.
b) Amplification through splitting in the number of dorsal or ventral bundles.
c) Reduction through fusion in the number of dorsal or ventral bundles.
d) Feeding of the style by different number (2-4) of vascular supplies of either dorsal or ventral; or dorsal and ventral; or septal or dorsal and septal.

8. NECTARIFEROUS DISC

Its nature can be comprehended through the gynoecium vasculature. Thus the disc is considered to be receptacular in taxa where the carpellary dorsal traces differentiate above its tissue. When the same differentiate betlow the disc, the latter is considered to be of carpellary nature. However, the rapid development of particular regions renders a difficulty to delimit its nature.

In accordance with the current evolutionary dicta the following are suggested for Boraginaceae as being primitive vs advanced.

Hexamerous flowers vs pentamerous vs Tetramerous; Actinomorphy vs Zygomorphy; Entire carpels vs Winged vs Ringed; Unfused carpellary walls vs Fused; Nectariferous disc present vs Absent; Terminal style vs Basal style; Forked stigma or fid or lobed vs Single (entire); Apical ovule vs Basal; Drupe vs Druplet vs Nutlet; Carpellary dorsal bundles absent vs present; Free vascular traces vs Fused; Ventral stylar supply vs Septal vs Dorsal.

The application of the above suggested dicta results in costructing some intra-affinities schemed in Fig. 1.
An abstract from this figure shows that:

1. No particular taxon possesses as much of primitive characters to be considered a hypothetical ancestor of the family. However, members of sub-families Ehretioideae and Cordioideae, although having some advanced characters (sensu stricto), appear likely to present the most primitive case among the taxa studied. The hypothetical ancestor of the Boraginaceae is to be searched for among the lower forms of Ehretioideae rather than in Cordioideae; the latter shows an advance over the former because of an apparent tendency towards fusion of the carpellary walls.

2. That the Boraginaceae is a natural family has been previously cited by Lawrence (1963) who reported that it is formed of closely related groups. Some other taxonomists raised the sub-families to the family rank viz. Cordiaceae, Ehretiaceae and Heliotropiaceae Brand (1921). Johnston

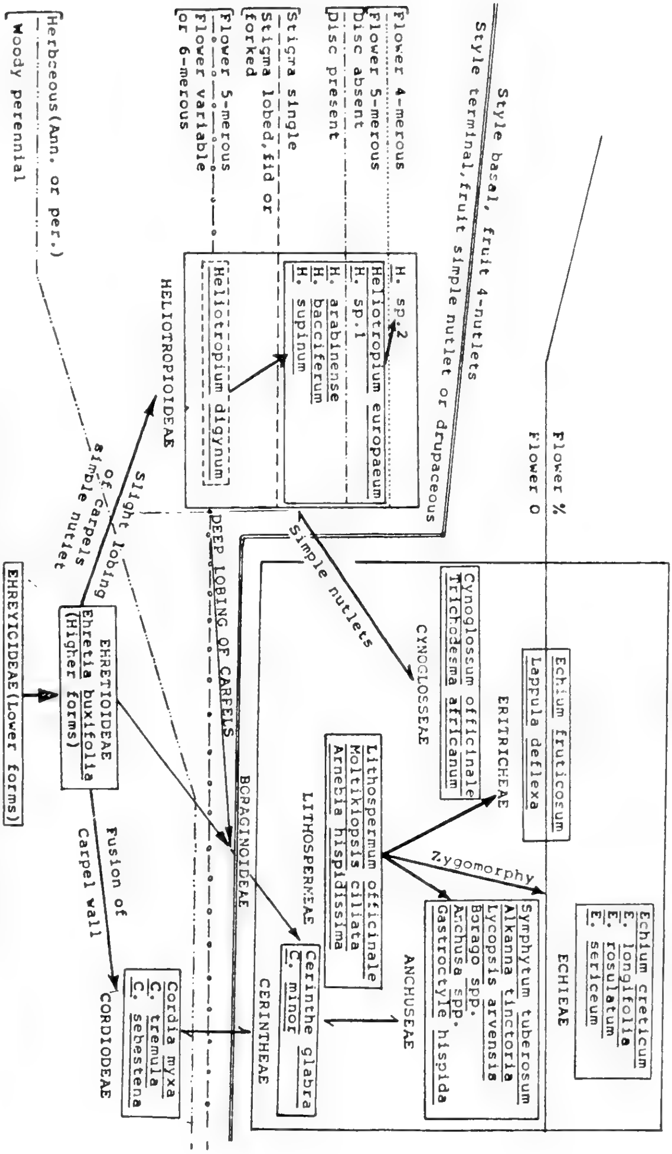

Fig.(1). The hypothetical ancestor of the Boraginaceae
K variable, C variable, A variable, G (2) unlobed, loosely united, style terminal, stigma lobed to forked.

Fig. 1. Presumed evolutionary trends in the Boraginaceae

(1923-49) and Lawrence (1937) were of the opinion that the Boraginaceae would best be considered as being composed of several sub-families rather than small micro-families. However, our data shows that affinities do exist and the different taxa show some sort of parallel evolution.

3. The limitation of hierarchial status to every species is rather difficult since all the taxa exhibit an amalgam of both advanced and less advanced characters. However, a predominance of certain characteristic feature (s) is generally observed for each taxonomic group.

4. The most variation in evolutionary trends is inherent to genus Heliotropium which may be a link between the primitive taxa of Ehretioideae and Cordioideae, on the one hand, and those of some advanced Boraginoideae on the other hand. In this connection Heliotropium digynum seems to be the core of this genus.

It may also be worthy to mention that a close relation between Heliotropioideae and Ehretioideae has been assumed by Di Fulvio (1978). Such relation is based on endosperm development, pollen morphology, floral vasculature and some pecularities of the ovules and the embryos. He also added that according to these similarities Hutchinson's classification (1948) may be refuted since he segregated the Ehretioideae as a separate family (Ehretiaceae) under the Verbenales.

5. An apparent relation is present between the studied Cordia spp. and those of Cerinthe. Thus it may be assumed that tribe Certintheae represents lower form in sub-family Boraginoideae. Also a possible relation is shown to exist between Cerinthe spp. and Gastroctyle hispida (Anchuseae). Cosequently the latter species may share a feature characteristic of the lower forms of tribe Anchuseae.

6. Sub-families Boraginoideae and Heliotropioideae can be linked via Tricnodesma africanum (Tribe Cynoglosseae) and Heliotropium spp. respectively. Such relation contradicts Hutchinson's view (1969) that group Heliotripeae should be given a family status leaving the true Boraginaceae.

7. The affinities in Fig. 1 reinforce the views of Willis (1967) that Echieae must be correctly separated form Lithospermeae on the basis of the high tendency of Echium towards zygomorphy. This disagrees with Johnston's classification of tribes Echieae and Cerintheae under Lithospeermeae.

8. The feeding of the style by septal and dorsal bundles is a characteristic features in Cerinthe glabra. On the other hand the stylar supply in Lithospermeae comes from dorsal bundles only. This may disagree with the view of Willis (1967) that Cerinthe would be a genus related to tribe Lithospermeae rather than being considered as a separate group. In spite of this, our suggestion to isolate Cerinthe as an independant genus agrees with the views of other authors (Post, 1932).

9. Our proposed relations between the tribes of Boraginoideae much agree with postulations of Johnston and Lawrence that the Anchuseae and Eritricheae have been derived from Lithospermeae and the Cynoglosseae from Lithospermeae through Eritricheae. The same authors also assumed that tribe Anchuseae might be separated as an off-shoot of Lithospermeae.

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LITERATURE CITED

1. Bessey, C.E. 1915. The phylogenetic taxonomy of flowering plants. Ann. Mo. Bot. Gard. 2: 109-164.
2. Brand, A., 1921. Borraginaceae-Borraginoideae-Cynoglosseae In Engler, Des Pflanzenreich, 78 (IV. 252): 1-236.
3. Chopra, G.L. 1971. Angiosperms, S. Magin & Co. Educational Publishers & Printers, Delhi, pp. 563.
4. Di Fulvio, T.E. 1978. Floral vascularization, embryology and chromosomes of Ixorhea tschudiana (Heliotropiaceae). Kurtziana, 11: 75-105.
5. Fabre, G. & Nicoli, R.M. 1974. Sur la morphologie des akenes de quelques Boraginacees de la flore de France. Interet systematique de cette etude. Bull. Soc. bot. Fr. 121, 133-144.
6. Gurke, M. 1897. Borraginaceae. In Engler and Prantl. Die naturlichen Pflanzenfamilien, Ed. 1, IV (3a): 71-131 (Cf. V. Puri 1951).
7. Hallier, H. 1912. L'Origine et le systeme phyletique des angiosperms. Arch. Neerl. Sci. Eact. Nat. Ser. 111 B, I: 146-234.
8. Hutchinson, J. 1948, British Flowering Plants. P.R. Gawthorn Ltd. London, p. 374.
9. __________, 1969. Evolution and phylogeny of Flowering Plants. Dicotyledons: Facts and Theory. Academic press, London, New York.
10. Johnston, I.M. 1923-1949. Studies in the Boraginaceae. I. Contr. Gray Herb. n.s. 68: 43-80, 1923; II, op. cit. 70: 1-61, 1924; III, op. cit. 73: 42-78, 1924; IV, op. cit. 74: 3-114, 1925; V., op. cit 75: 40-49, 1925; VI, op. cit. 78: 1-118, 1927; VII, op. cit., 81: 1-83, 1928; VIII, op. cit., 92: 1-95, 1930; IX, Contr. Arnold Arb. 3: 1-102, 1932; X Journ. Arnold Arb. 16: 1-67, 1935; XI, op. cit., 145-205, 1935; XII, op. cit. 18: 1-25, 1937; XIII, op. cit. 20: 375-402, 1939; XIV, op. cit., 21: 48-66 1940; XV, op. cit. 336-355, 1940; XVI, op.cit. 29: 227-241, 1948; XVII, op. cit. 30: 85-110, 1949, XVIII, op. cit. 30: 111-138, 1949.
11. Joshi, B.M. 1975, Studies in Boroginaceae. I-Floral anatomy of Bothriospermum tenellum Fisch. et Mey. Geobios, 2: 10-12.

12. ___________ , 1976. Studies in Boraginaceae. II. Morphology of gynoecium with special reference to evolution of the parietal placentation. Geobios, 3: 76-78.

13. Khalifa, S.F. & Hamed, K. 1982. Studies on the Boraginaceae. I. Taxonomic trends in selected species of Heliotropium. Bull. Fac. Agric. Ain Shams Univ., Cairo, No. 1960.

14. Lawrence, J.R. 1937. A correlation of the taxonomy and the floral anatomy of certain of the Boraginaceae. Amer. Jour. Bot. 24: 433-444.

15. Lawrence, G.H.M. 1963: Taxonomy of vascular plants. The Macmillan Comp. New York, 823pp.

16. Moore, J.A. 1936a. Morphology of the gynobase in Mertensia. Amer. Midl. Nat. 17, 749-752.

17. ___________ , 1936b. The vascular anatomy of the flower in the Papilionaceous Leguminoseae. Amer. Jour. Bot., 23, 279-290.

18. Post, G.E. 1982. Flora of Syria, Palestine and Sinai. American Press, Beirut, Vol. II: 215-255.

19. Puri, V. 1951. The role of floral anatomy in the solution of morphological Problems. Bot. Rev. 17: 471-553.

20. Riedl, H. 1967. Boraginaceae. In RECHINGER, K.H. (Ed.) Flora Iranica. Graz. Akad. Druck -u. Verlagsanst.

21. Schleiden, M.I. 1849. Principles of scientific botany (Cf. V. Puri 1951).

22. Schmida, A. 1978. Relationships between Paracaryum intermedium and P. boissieri in Sinai, and the generic separation of Paracaryum and Mattiastrum (Boraginaceae). Pl. Syst. Evol. 129, 323-326.

23. Takhtajan, L. 1980. Outline of the classification of flowering plants. Bot. Rev. Vol. 46 No. 3.

24. Wettstein, R. 1901. Handbuch der systematischen Botanik. Leipzig ed. 4, 2, vols, 1935.

25. Willis, J.C. 1967. A Dictionary of the Flowering Plants and Ferns. Cambridge University Press.

NOTES ON THE GENUS *CLERODENDRUM* (*VERBENACEAE*). XXXII

Harold N. Moldenke

CLERODENDRUM Burm.

Additional & emended bibliography: Oliv., Trans. Linn. Soc. Lond. 29: 132--133, pl. 89. 1875; Pulle in Lorentz, Nova Guinea, ser. 1, 8: 402--403 (1910) and ser. 1, 8: 687. 1912; Léveillé, Fl. Kouy-Tchéou 441--442. 1915; Menninger, Stuart News p. 4, Jan. 11. 1945; W. Trelease, Wint. Bot., ed. 3, imp. 2, 331. 1967; Prasad, Mehta, & Dave, Biol. Pl. Prague 26: 321--326. 1984; Prasad, Mehta, & Dave, Biol. Abstr. 79: AB.838. 1985; Mold., Phytologia 62: 78--86. 1987.

CLERODENDRUM LONGIPETIOLATUM Gürke

Additional bibliography: Mold., Phytologia 62: 86. 1987.

Lower bracts lanceolate, to 5 cm. long, apically acute, basally narrowed into the stipe, the upper ones linear or subulate, 2--3 mm. long; pedicels elongate; calyx campanulate, 6--7 mm. long, subglabrous, 5-parted to below the middle, the lobes narrowly lanceolate, apically long-acuminate or caudate, longer than the tube; corolla hypocrateriform, the tube 1.5--1.8 cm. long, 2--2½ times the length of the calyx, externally glabrous.

This species is based on *Stuhlmann 71* from Mrgoro, Ukami, Zanzibar, collected on May 18, 1890, and deposited in the Berlin herbarium, now unfortunately destroyed.. It should be noted that Baker (1900) reverses the bract description, asserting that it is the lower bracts that are linear and the upper that are lanceolate; Gürke's (1893) original description is the more accurate. Gürke's reference is sometimes erroneously dated as "1894", the titlepage date.

The species is a member of the Subgenus *Euclerodendrum* (Schau.) Thomas, Section *Oxycalyx* Thomas, Subsection *Acuminata* Thomas. A key to help distinguish it from related African species will be found under C. *dinklagei* Gürke in the present series of notes [59: 254--255]. The later homonymous C. *longipetiolatum* P'ei is now known as C. *peii* Mold., which see.

Nothing is known to me of C. *longipetiolatum* Gürke beyond what is stated in its bibliography. Thomas (1936) knew it only from the type collection.

CLERODENDRUM LONGISEPALUM Dop in Lecomte, Notul. Syst. 4: 11--12 [as "*Clerodendron*"]. 1920; Mold., Known. Geogr. Distrib., Verbenac., ed. 1, 59 & 90. 1942.

Synonymy: *Clerodendron longisepalum* P. Dop in Lecomte, Notul. Syst. 4: 11. 1920.

Bibliography: Dop in Lecomte, Notul. Syst. 4: 11--11. 1920; A. W. Hill, Ind. Kew. Suppl. 6, imp. 1, 49. 1926; Fedde & Schust., Justs. Bot. Jahresber. 48 (1): 497. 1927; Dop in Lecomte, Fl. Gén. Indo-chine 4: 851 & 865--867, fig. 89 (3--7). 1935; Worsdell, Ind. Lond. Suppl. 1: 238. 1941; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 59 & 90

(1942) and ed. 2, 136 & 182. 1949; A. W. Hill, Ind. Kew. Suppl. 6, imp. 2, 49. 1959; Mold., Résumé 175, 427, & 451. 1959; Mold., Résumé Suppl. 1: 12 (1959) and 3: 19. 1962; Mold., Fifth Summ. 1: 300 (1971) and 2: 868. 1971; Mold., Phytologia 31: 395. 1975; Mold., Phytol. Mem. 2: 239, 291, 387, & 539. 1980; P. Hplmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 60: 142. 1986.

Illustrations: Dop in Lecomte, Fl. Gén. Indo-chine 4: 865, fig. 89 (3--7). 1935.

A shrub, 1--3 m. tall; branchlets terete, puberulent, finally glabrous; bark reddish-brown; leaves decussate-opposite, fetid; petioles slender, 8--10 mm. long; leafblades membranous, elliptic or elliptic-oblong to ovate, about 8 cm. long and 2.5 cm. wide, apically acute or shortly acuminate, marginally irregularly serrate or sinuate-dentate to subentire, basally cuneate or attenuate, glabrous; secondaries 8 per side, slender; veinlets conspicuous; inflorescence paniculate, large, ample, 30--40 cm. long, 20 cm. wide, conspicuously foliose, puberulent; peduncles divaricate, 4 cm. long; bracts foliaceous; bractlets linear, 3--4 mm. long; cymes 5-flowered; flowers 3--4 cm. long; calyx obconic, 12--16 mm. long, externally sparsely pilose throughout, not accrescent in fruit, the tube 1.5 mm. long, the lobes slightly unequal, linear, 12--15 mm. long, 1.5 mm. wide, vittate, apically acute; corolla white, puberulent, the tube slender, 2.5--3 cm. long, the lobes ovate, 7--8 mm. long, apically obtuse; stamens exserted; filaments white; stigma shortly bifid; ovary truncate; fruit drupaceous, blackish-purple or black, 8 mm. wide, included by the erect fruiting-calyx lobes, composed of 2 pyrenes.

This species is based on *Pierre 5221* from Bien-Hoa, Cochinchina, *Colliard s.n.* from Kompong-Thom and *Lecomte & Finet 1804* & *1805* from Angkor, Cambodia, and *Harmand 17* & *38* from Bassim du Semoun and *Thorel 2767* from Kemarath, Laos. Dop (1920) comments that this species is "distincte de toutes les autres du genre par la form du calice". The Clemenses report it frequent along forest trails in Annam, describing it as a "beautiful undershrub". It has been collected in anthesis in August.

Fedde & Schuster (1927) cite all the original collections except that of Colliard.

A key to help distinguish this species from other Indochinese taxa will be found under C. *hahnianum* Dop in the present series of notes [60: 141--143].

Citations: VIETNAM: Annam: *Clemens & Clemens 4261* (Ca--339356). Cochinchina: *Pierre 5221* (B--cotype, Bz--72800--cotype, Ca--53730--cotype, F--photo of cotype, Ld--photo of cotype, N--cotype, N--photo of cotype, S--cotype, Sg--photo of cotype). LAOS: *Harmand s.n.* [Bassin du Se-Moun] (B--cotype). MOUNTED ILLUSTRATIONS: Dop in Lecomte, Fl. Gén. Indo-chine 4: 865, fig. 89 (3--7). 1935 (Ld).

CLERODENDRUM LUEMBENSE DeWild., Bull. Jard. Bot. Brux. 3: 267 [as "*Clerodendron*"]. 1911; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 84 & 94. 1936.

Synonymy: *Clerodendron luembense* DeWild., Bull. Jard. Bot. Brux.

3: 267. 1911. *Clerodendron luembensis* DeWild., Feddes Repert. Spec. Nov. 13: 145 sphalm. 1914. *Clerodendrum lumbuense* DeWild. ex Mold., Phytologia 59: 264 sphalm. 1986.

Bibliography: DeWild., Bull. Jard. Bot. Brux. 3: 267. 1911; De Wild., Feddes Repert. Spec. Nov. 13: 145. 1914; Fedde & Schust., Justs Bot. Jahresber. 40 (2): 335. 1915; Prain, Ind. Kew. Suppl. 5, imp. 1, 62. 1921; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 47, 84, & 94. 1936; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 47, 48, & 90 (1942) and ed. 2, 113, 115, & 182. 1949; Mold., Résumé 139, 141, 148, 150, & 451. 1959; Prain, Ind. Kew. Suppl. 5, imp. 2, 62. 1960; Mold., Fifth Summ. 1: 223, 229, 245, & 251 (1971) and 2: 868. 1971; Mold., Phytol. Mem. 2: 214, 219, 235, 240, & 539. 1980; P. Holmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 59: 110, 264, & 350. 1986.

A subshrub; branches erect, to 5.5 cm. long, velutinous; leaves decussate-opposite or ternate; leafblades obovate, 6--12.5 cm.long, 2--4 cm. wide, apically more or less broadly cuneate, marginally denticulate or coarsely serrate near the apex, basally long-cuneate, glabrous on both surfaces; inflorescence terminal, paniculate, sparsely foliose; peduncles to 35 cm. long, short-tomentose; cymes 3-flowered, basally bracteolate; bractlets lanceolate or linear, about 2 mm. long, velutinous; pedicels to 4 mm. long, velutinous; calyx about 4 mm. long, 5-lobed, externally velutinous, the lobes not inrolled, sometimes somewhat overlapping, rounded, marginally ciliate, broadly ovate; corolla-tube about 8--9 mm long, the apex more or less hairy, the lobes marginally ciliate, otherwise glabrous; stamens and style exserted; stigma bilobed; ovary internally hairy.

The species is based on an unnumbered A. Hock collection from the valley of the small Luembe in Katanga, Zaire, collected sometime in 1910 and deposited in the Brussels herbarium. DeWildeman (1911) comments that it is a member of the Subgenus *Cyclonema*, in the affinity of *C. myricoides* (Hochst.) R. Br. and close to *C. katangense* DeWild. In his 1914 work he emphasizes its relationship with *C. corbisieri* DeWild., *C. erectum* DeWild., and *C. ringoeti* DeWild. Thomas (1936) cites only the original collection.

Collectors describe this plant as an herb, about 2 feet tall, or shrubby, to 7 feet tall, the stem thick, unbranched, to 1 m. tall. On *Hornby 3720* the corollas are described as "white", while on *Chapin 529* they are said to have been the "lowermost (central) petal light-purplish inside, but greenish in the mid-line, the rest of the flower light-green". The plant has been collected in anthesis in March and August. Hornby encountered it in sandy soil of "grasslands with woody elements". The Milne-Redhead collection, previously distributed as *C. discolor* var. *kilimandscharense* Thomas, had "the flowers all fallen, leaves young".

Citations: ZAIRE: *Chapin 529* (N); *Giorgi s.n.* [Envir. Elisabethville, 1923] (Br); *Hock s.n.* [Luembe, Katanga, 1910] (Br--type, Ld--photo of type, N--fragment & photo of type); *Quarré 2302* (Br). ZAMBIA: *E. Milne-Redhead 625* (Br, F--photo, K, Ld--photo, N--photo, Sg--photo). MOZAMBIQUE: Moçambique: *Hornby 3720* (Af).

CLERODENDRUM LUEMBENSE var. *ALBINERVUM* Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 84. 1936

Synonymy: *Clerodendrum luembense* var. *albinervium* Thomas ex Mold., Known Geogr. Distrib. Verbenac., ed. 1, 47 & 90 sphalm. 1942.

Bibliography: B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 84. 1936; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 47 & 90 (1942) and ed. 2, 113 & 182. 1949; Mold., Résumé 139 & 451. 1959; Mold., Fifth Summ. 1: 223 (1971) and 2: 868. 1971; Mold., Phytol. Mem. 2: 214 & 539. 1980.

According to Thomas (1936) this variety differs from the typical form of the species in having the "Blattnerven auf Unterseits fell behaart; ganze Behaarung weich, Haare nach rückwärts gekrümmt."

It is based on *Ledermann 3756* from Sagdasche, at 500--700 m. altitude, in the Sari Mountains, Cameroons, collected in May, 1909, and deposited in the Berlin herbarium, now destroyed. Thomas (1936) cites also *Ledermann 3911* & *3989* from the same locality.

Nothing is known to me of this taxon beyond what is stated in its meager bibliography (above).

CLERODENDRUM LUZONIENSE Merr., Philip. Journ. Sci. Bot. 20: 436 [as "*Clerodendron*"]. 1922; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 62 & 90. 1942.

Synonymy: *Clerodendron luzoniense* Merr., Philip. Journ. Sci. Bot. 20: 436. 1922.

Bibliography: E. D. Merr., Philip. Journ. Sci. Bot. 20: 436. 1922; E. D. Merr., Enum. Philip. Flow. Pl. 3: 403. 1923; A. W. Hill, Ind. Kew. Suppl. 7: 51. 1929; Fedde & Schust., Justs Bot. Jahresber. 53 (1): 1072. 1932; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 62 & 90 (1942) and ed. 2, 141 & 182. 1949; Mold., Résumé 183 & 451. 1959; Mold., Fifth Summ. 1: 316 (1971) and 2: 868. 1971; Mold., Phytol. Mem. 2: 306 & 539. 1980.

A glabrous, erect shrub; branches slender, pale; leaves decussate-opposite; petioles 2--5 cm. long; leafblades membranous, elliptic to oblong-elliptic, 13--18 cm. long, 6--7 cm. wide, apically rather slenderly acuminate, marginally entire, basally cuneate, somewhat olivaceous and shiny on both surfaces when dry or the lower surface somewhat paler, not glandulose; secondaries 6 or 7 per side, slender, rather prominent beneath; veinlet reticulation very loose; inflorescence terminal, paniculate, pedunculate, lax, few-flowered, glabrous or very slightly puberulent, the peduncle and rachis to 12 cm. long; inflorescence branches few, spreading, each usually 3-flowered; bracts linear, 4--6 mm. long, apically acuminate; bractlets similar, smaller; pedicels 1--1.6 cm. long; calyx green, 5--7 mm. long, basally cuneate, 5-lobed, the lobes lanceolate, about 3 mm. long, apically acuminate; corolla hypocrateriform, white, the tube slender, 5--6 cm. long, straight, the lobes spreading, oblong-elliptic, about 1 cm. long, apically obtuse.

This species is based on *Ramos & Edaño, Herb. Philip. Bur. Sci. 33784* from Paracale, Camarines Province, Luzon, Philippine Islands, collected between May and December. Merrill (1922, 1923) cites also *Ramos & Edaño, Herb. Philip. Bur. Sci. 33779* from Luzon and states

that this species is endemic to Luzon, inhabiting damp forests along small streams at low altitudes. It has been collected in anthesis in November and December. Merrill further comments that "The alliance of this species is manifestly with C. *klemmei* Elm., from which it is distinguished by its differently shaped, relatively much broader leaves, longer flowers, lax, few-flowered inflorescences, and narrower calyx teeth."

Material of C. *luzoniense* has been distributed in some herbaria as "C. cfr. *mindorense* Merr."

Citations: PHILIPPINE ISLANDS: Luzon: *Ramos & Edano, Herb. Philip. Bur. Sci. 33779* (W--1263506), *33784* (Ld--photo of isotype, W--isotype.

CLERODENDRUM MABESAE Merr., Philip. Journ. Sci. Bot. 12: 302 [as "*Clerodendron*"]. 1917; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 62 & 90. 1942.

Synonymy: *Clerodendron mabesae* Merr., Philip. Journ. Sci. Bot. 12: 302. 1917.

Bibliography: E. D. Merr., Philip. Journ. Sci. Bot. 12: 302. 1917; Fedde & Schust., Justs Bot. Jahresber. 45 (1): 148. 1923; E. D. Merr., Enum. Philip. Flow. Pl. 3: 403. 1923; A. W. Hill, Ind. Kew. Suppl. 6, i,p. 1, 49. 1926; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 62 & 90. 1942; H. N. & A. L. Mold., Pl. Life 2: 70. 1948; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 141 & 182. 1949; A. W. Hill, Ind. Kew. Suppl. 6, imp. 2, 49. 1959; Mold., Résumé 183 & 451. 1959; Mold., Fifth Summ. 1: 316 (1971) and 2: 868. 1971; Mold., Phytol. Mem. 2: 306 & 539. 1980.

A glabrous tree, about 7 m. tall; branches brownish; ultimate branchlets somewhat tetragonal; leaves decussate-opposite; petioles 4--5 cm. long; leafblades submembranous, oblong to oblong-obovate, 30--36 cm. long, 8--12 cm. wide, apically acuminate, marginally entire or with a few, widely scattered, minute teeth, basally acute, greenish or olivaceous and similar in color on both surfaces when dry, shiny and minutely punctulate on both surfaces; secondaries about 10 per side, curvate, prominent, anastomosing, the primary reticulations very lax and prominent; inflorescence terminal, paniculate, about 10-flowered; peduncles very short, about 2 cm. long if the rachis is included; calyx chartaceous, somewhat inflated, about 4 cm. long, externally glandular-punctate, brunnescent in drying, somewhat angular, basally cuneate, 5-lobed to about the middle, the lobes narrowly lanceolate, apically acuminate; corolla hypocrateriform, white, the tube slender, about 12 cm. long and 2 mm. wide, the lobes spreading, lanceolate to oblanceolate, about 4 cm. long, 5--7 mm. wide.

This species is based on *Mabesa, Herb. Philip. For. Bur. 26796* from moist shaded slopes in forests back of Paete, at about 370 m. altitude, Laguna Province, Luzon, Philippine Islands, collected on March 27, 1917. Merrill (1917) notes that this is "A remarkable species, manifestly allied to *Clerodendron minahassae* Miq., from which it differs in its much longer flowers." In his 1923 work he states that the species is endemic to Luzon, inhabiting primary for-

ests at about 300 m. altitude. It is known to me thus far only from the original collection.

Citations: PHILIPPINE ISLANDS: Luzon: *Mabesa, Herb. Philip. For. Bur. 26796* (Ld--photo of isotype, N--photo of isotype, W--1375168--isotype).

CLERODENDRUM MACROCALYCINUM J. G. Baker, Journ. Linn. Soc. Lond. Bot. 18: 275 [as "*Clerodendron*"]. 1881; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 53 & 90. 1942.

Synonymy: *Clerodendron macrocalycinum* Baker, Journ. Linn. Soc. Lond. Bot. 18: 275. 1881.

Bibliography: J. G. Baker, Journ. Linn. Soc. Lond. Bot. 18: 275. 1881; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 561. 1893; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 53 & 90 1942: Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 561. 1946; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 123 & 182. 1949; Mold. in Humbert, Fl. Madag. 174: 151, 203--205, 266, & 268, fig. 33 (1). 1956; Mold., Résumé 155 & 451. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 561. 1960; Mold., Fifth Summ. 1: 260 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 249 & 539. 1980; Mold., Phytologia 58: 187. 1985.

Illustrations: Mold. in Humbert, Fl. Madag. 174: 205, fig. 33 (1). 1956.

A shrub or small bushy tree; branchlets and twigs very obtusely tetragonal, grayish, usually slightly compressed at the nodes, the younger parts densely puberulent with very minute brownish hairs, the older parts glabrescent, lenticellate; leaf-scars large and prominent, corky-margined; nodes not annulate; principal internodes 0.5--4 cm. long, mostly much abbreviated; leaves decussate-opposite; petioles very slender, 0.5--2 cm. long, very minutely puberulent or subglabrate; leafblades thin-membranous, bright-green, lighter beneath, often more or less brunnescent in drying, narrowly elliptic or oblanceolate, 4.5--8 cm. long, 1.5--2.5 cm. wide, apically acute or obtuse, marginally entire, basally attenuate-acute, glabrous above, very minutely and obscurely puberulent or glabrate beneath; midrib slender, flat above, prominulous beneath; secondaries filiform, 5--9 per side, flat above, subprominulous beneath, arcuate-ascending, very obscurely anastomosing at the margins; veinlet reticulation very sparse, practically indiscernible on both surfaces; inflorescence terminal, paniculate, composed of 2--4 pairs of mostly 3-flowered cymules; peduncles obsolete or to 1.5 cm. long, practically glabrous; rachis subglabrous; inflorescence ramifications 1.5--4 cm. long, glabrate; pedicels filiform, 7--15 mm. long, glabrous; foliaceous bracts absent; bractlets setaceous, 1--3 mm. long, glabrate; calyx thin-membranous or chartaceous, cylindric, about 1.6 cm. long during anthesis, 8--13 mm. wide, externally glabrous, longitudinally venose, the rim 5-lobed, the lobes triangular-ovate, about 3 mm. long, apically acute; corolla hypocrateriform, succulent, rose-violet or bright-red, its tube very narrow-cylindric, 2.5--3.5 cm. long, 1--1.5 cm. wide, externally glabrous, the limb 2.5 cm. wide, the lobes obovate, about 12 mm. long and 7 mm. wide, apically

rounded, glabrous; stamens and pistil exserted about 1 cm. from the corolla-mouth; fruiting-calyx to 2.3 cm. long; fruit not known.

This endemic species is based on *Kitching s.n.* from Tanala, Madagascar, deposited in the Kew herbarium. Collectors have found it growing in relic forests and littoral forests, to 2000 m. altitude, in flower in July and November. The corollas are said to have been "rouge vif" on *Humbert 3289* and "rose violacé" on *Decary 10125*.

A key to help distinguish this species from other Madagascar taxa will be found under *C. baronianum* Oliv. in the present series of notes [58: 184--190]. Material has been misidentified and distributed in some herbaria as *C. arenarium* J. G. Baker.

Citations: MADAGASCAR: *Baron 1211* (K); *Decary 10125* (N, P), *10755* (P); *Humbert 3289* (P); *Kitching s.n.* [Tanala] (E--photo of type, F--photo of type, K--type, Ld--photo of type, N--photo of type).

CLERODENDRUM MACROCALYX H. J. Lam, Verbenac. Malay. Arch. 293--294 [as "*Clerodendron*"]. 1919; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 62 & 90. 1942 [not *C. macrocalyx* DeWild., 1920].

Synonymy: *Clerodendron macrocalyx* H. J. Lam, Verbenac. Malay. Arch. 293. 1919.

Bibliography: H. Hallier, Meded. Rijks Herb. Leid. 37: 68. 1918; H. J. Lam, Verbenac. Malay. Arch. 293--294 & 364. 1919; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 90, 109, & ix. 1921; E. D. Merr., Enum. Philip. Flow. Pl. 3: 403. 1923; A. W. Hill, Ind. Kew. Suppl. 6, imp. 1, 49. 1926; Fedde & Schust., Justs Bot. Jahresber. 60 (2): 572. 1941; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 62 & 90 (1942) and ed. 2, 141 & 182. 1949; Mold., Alph. List Cit. 4: 1115. 1949; Pételot, Pl. Med. Camb. Laos Vietn. 2: 253 (1954) and 4: 99. 1954; A. W. Hill, Ind. Kew. Suppl. 6, imp. 2, 49. 1959; Mold., Résumé 183 & 451. 1959; Mold., Fifth Summ. 1: 316 (1971) and 2: 869. 1971; Mold., Phytologia 31: 395. 1975; Mold., Phytol. Mem. 2: 306, 387, & 539. 1980; P. Holmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 58: 448 (1985), 59: 119 (1986), and 61: 467 & 468. 1987.

A shrub, 2--5 m. tall; stems 4--8 cm. in diameter; branchlets terete, densely fulvo-pubescent or -hirtellous; leaves decussate-opposite; petioles 3.5--7.5 cm. long, densely hirtellous or fulvo-pubescent; leafblades chartaceous, cordate- or subcordate-ovate or subrotund, 13--19 cm. long, 9.5--16 cm. wide, apically acuminate, marginally entire or sometimes more or less irregularly undulate or denticulate, basally cordate or subcordate and sub-3- or 5-veined, pubescent on both surfaces, especially beneath, not glandulose; secondaries 5--7 per side, densely lanate; inflorescence terminal, paniculate, 10--15 cm. long, 8 cm. wide, few-flowered, densely hirtellous or fulvo-pubescent; peduncles 2.5--5 cm. long; pedicels 3--12 mm. long; bractlets 2, alternate or opposite, setaceous, 2--3 mm. long; calyx large, 2.5--3 cm. long, apically constricted, basally subinflated, often red, densely pubescent, not glandulose, the rim 5-dentate, the teeth narrow, linear, 6--10 mm. long, apically very acute; corolla hypocrateriform, white, slightly exserted, the tube slender, 3.3 cm. long, the upper part sparsely villous, the lobes

elliptic, about 6 mm. long and 3.5 mm. wide, apically obtuse, villous; stamens exserted about 1 cm. from the corolla-mouth, inserted at the middle or in the upper part of the corolla-tube; stigma shortly bifid; ovary externally glabrous; fruiting-calyx not at all or only slightly incrassate and accrescent, including the [immature] fruit; fruit drupaceous, blue-green, globose, shiny.

This species is based on *Elmer 11338* from Todaya (Mt. Apo), Davao, Mindoro, Philippine Islands, collected in flower in July, 1909, and in fruit in August of the same year. Lam (1919) remarks that this is "A plant, remarkable for its large calyx, in which it is nearly conform [sic] with C. *Preslii*; it differs from that species, however, in several points, such as the broader leaves, the puberulous corolla, the insertion of the stamens, the non-glandular calyx and lower side of the leaves and their densier [sic] tomentum. Further it is allied to C. *lanuginosum* in almost all characteristics, except for the extraordinarily large calyx."

The C. *macrocalyx* DeWild., referred to above, is a synonym of C. *fuscum* Gürke.

Collectors have encountered *Clerodendrum macrocalyx* H. J. Lam in forests and along damp forest streams, at 150--650 m. altitude, in flower from April to October, and in fruit in May, June, and August. Merrill (1923) asserts that it is endemic to Mindanao, where it occurs in thickets and secondary forests at low and medium altitudes, citing *Ahern 691, Clemens 662, DeVore & Hoover 173, Elmer 11338, Mallonga, Herb. Philip. For. Bur. 26265,* and *Ramos & Pascasio, Herb. Philip. Bur. Sci. 34382, 34904,* & *35024.*

The corollas are said to have been "white" on *Clemens 1960* and *Wenzel 3376,* "white and pink" on *Wenzel 2621,* "white & red" on *Wenzel 3376,* and "violet" on *Lagrimas 213.* A vernacular name recorded for the species is "taquipan".

On *Clemens 1960* the label bears this note: "This tree appeared to be attached to a different tree near the ground". On the label accompanying *Herb. Philip. For. Bur. 31154* is written "collector died leaving no record about this specimen from Jolo".

Material of C. *macrocalyx* has been misidentified and distributed in many herbaria as C. *lanuginosum* Blume or as C. *villosum* Blume. On the other hand, the *Ramos, Herb. Philip. Bur. Sci. 42689,* distributed as C. *macrocalyx,* actually is C. *cumingianum* Schau.

Citations: PHILIPPINE ISLANDS: Mindanao: *Ahern 691* [field no. 91] (W--445426, W--445861), *691Q* (Bz--19906, Bz--19907); *M. S. Clemens 1960* [Herb. Philip. Bur. Sci. 15619] (B, Bz--19905, Ca--238482, Ca--268483, W--1527554); *DeVore & Hoover 173* (W--449404); *Elmer 11338* (Bi--isotype, Bz--19902--isotype, Du--175582--isotype, L--isotype, Mi--isotype, N--isotype, Ut--27513--isotype, Vt--isotype, W--711971-isotype); *Lagrimas 213* (W--2245806); *Mallonga, Herb. Philip. For. Bur. 26265* (Bz--19904, W--1292866); *Ramos & Edaño, Herb. Philip. Bur. Sci. 49536* (B, Ca--323907, N); *Wenzel 2621* (Au, Ca--316903, Mu, N), *3376* (Br, Bz--19903, Ca--354958, Ms, Mu, N). Siargao: *Ramos & Pascasio, Herb. Philip. Bur. Sci. 35024* (W--1263819). Sulu: *Antonio 18* [Herb. Philip. For. Bur. 31154] (Mi, N).

CLERODENDRUM MACROSTACHYUM Turcz., Bull. Soc. Nat. Mosc. 36 (2): 220--221 [as "*Clerodendron*"]. 1863; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 54, 61, & 90. 1942 [not *Clerodendron macrostachyum* J. G. Baker, 1898].

Synonymy: *Verbenacear familiae p. angulata* Wall., Numer. List 215, no. 6316. 1832. *Clerodendron macrostachyum* Turcz., Bull. Soc. Nat. Mosc. 220. 1863. *Clerodendron n.34* Hook. f. & Thoms. ex C. B. Clarke in Hook. f., Fl. Brit. India 4: 591 in syn. 1885. *Verbenacea* Wall. ex C. B. Clarke in Hook. f., Fl. Brit. India 4: 591 in syn. 1885. *Clerodendron subscaposum* Hemsl. in Oliv., Hook. Icon. Pl. 27: pl. 2675. 1900. *Clerodendron scaposum* Hemsl. ex Léveillé, Fl. Kouy-Tchéou 442. 1915. *Clerodendrum scaposum* Hemsl. ex Lauener, Notes Roy. Bot. Gard. Edinb. 38: 484. 1980.

Bibliography: Wall., Numer. List 215, no. 6316. 1832; Turcz., Bull. Soc. Nat. Mosc. 36 (2): 220--221. 1863; C. B. Clarke in Hook. f., Fl. Brit. India 4: 591--592. 1885; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 561. 1893; Briq. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, 4 (3a): 175. 1895; J. G. Baker in Thiselt.-Dyer, Fl. Trop. Afr. 5: 313. 1900; Hemsl. in Oliv., Hook. Icon. Pl. 27 [ser. 7, 5]: pl. 2675. 1900; K. Schum., Justs Bot. Jahresber. 28 (1): 495. 1900; Brandis, Indian Trees, imp. 1 & 2, 508 (1906), imp. 2a, 508 (1907), and imp. 3, 508. 1911; Léveillé, Fl. Kouy-Tchéou 442. 1915; Léveillé, Cat. Pl. Yun-nan 277. 1917; H. J. Lam, Verbenac. Malay. Arch. 264 & 364. 1919; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 87, 95, 109, & ix. 1921; Brandis, Indian Trees, imp. 4, 508. 1921; Rodger in Lace, List Trees Shrubs Burma, ed. 2, 132. 1932; Chung, Mem. Sci. Soc. China 1 (1): 228. 1924; P'ei, Mem. Sci. Soc. China 1 (3): 128--129, pl. 24. 1932; Kanjilal, Das, Kanjilal, & De, Fl. Assam, imp. 1, 3: 486, 492, & 546. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 54, 61, & 90. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 561. 1946; Mold., Alph. List Cit. 2: 559 (1948) and 3: 668. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 126, 139, 144, & 182. 1949; Mold., Résumé 161, 169, 175, 179, 190, 270, 274, & 451. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 561. 1960; Hundley & Ko in Lace, Trees Shrubs Burma, ed. 3, 203. 1961; Brandis, Indian Trees, imp. 5, 508. 1971; Mold., Fifth Summ. 1: 273, 288, 300, 304, 322, 456, & 466 (1971) and 2: 707, 869, & 972. 1971; Lauener, Notes Roy. Bot. Gard. Edinb. 38: 484. 1980; Mold., Phytol. Mem. 2: 257, 272, 277, 291, 295, 313, 387, 390, & 539. 1980; Kanjilal, Das, Kanjilal, & De, Fl. Assam, imp. 2, 3: 486. 1982; Mold., Phytologia 60: 135, 136, & 141. 1986.

Illustrations: Hemsl. in Oliv., Hook. Icon. Pl. 27 [ser. 7, 5]: pl. 2675. 1900; P'ei, Mem. Sci. Soc. China 1 (3): pl. 24. 1932.

A rather herbaceous plant, to 2 m. tall, growing in limestone; stems subfleshy, thick, often prostrate, softly glandular-hirtellous; bark loose, deciduous; floriferous stems (or scapes) erect, slender, about 45 cm. tall, smooth, glabrous; basal leaves long-petiolate, erect; petioles 15--25 cm. long, thick, subglabrous or glandular-hirtellous; stem leaves 2, sessile, small, ovate, borne at the middle of the floriferous stem; basal leafblades membranous,

ovate, 10--33 cm. long, 8--16 cm. wide, apically acute or subacute to acuminate, marginally coarsely repand (often obscurely so) or repand-dentate to almost lobed, basally deeply cordate, sparsely short-pilose on roughened dots or hispidulous above, often whitened or grayish-downy and resinous-punctate beneath, pilosulous on the venation or glabrescent, the larger venation rather conspicuous; secondaries about 8 per side; inflorescence terminal, paniculate, much elongate, to 27 cm. long, sometimes compound, the ramifications long, the panicles narrow, the cymes remote, opposite or subverticillate, few- or many-flowered, somewhat glandular-pubescent or glabrate, toward the base 2-parted and 2-flowered; bracts small, linear-lanceolate or ovate (the smaller ones oblong), 4 mm. long, acuminate at both ends; pedicels filiform, 1.2--2.7 cm. long; calyx hemispheric, cupuliform, very small, 1--2 mm. long, apically 2 mm. wide, externally glabrate or obscurely pubescent, often with a few red glands, internally glabrous, the rim shallowly toothed, the teeth short, rounded; corolla delicate, 8--10 mm. long, pale-blue or blue, glabrous, often with a few glands, the tube short, linear, 5 mm. long, the lobes ovate-oblong or obovate, 5 mm. long, apically obtuse; stamens long-exserted; style subterminal, exserted, glabrous; ovary apically pilose, 2 or imperfectly 4-celled, 4-ovulate, with large red glands; fruiting-calyx unaltered or slightly inflated; fruit drupaceous, obovoid, about 2 mm. long, nearly dry, externally covered with red glands, ultimately splitting into 4 pyrenes.

This curious species is based on *Lobb 361* from Singapore (according to Turczaninow), Moulmein, Burma (according to Clarke), or Java (according to a herbarium label). Turczaninow (1861) comments that the "Inflorescentia singularis, ramuli leviter arcuato-deflexi, petiolus foliorum inferiorum foliis longior, superius sensim decrescit, ita ut summa folia, diminuta et difformia, omnino sint sessilia." He placed the species in what he called the "*Eucleroden-dea racemiflora*". Clarke (1885) avers that it is "Not allied to any other *Clerodendron*. The Moulmein material has smaller, less toothed, leaves, and has more pubescence and glands than the Chela plants." He cites unnumbered Wallich and Hooker & Thomson material from the limestone rocks above Chela, at 2000 feet altitude, in the Khasia hills, a Clarke collection from 5000 feet altitude, in the Upper Kala Pani, also in Khasia, and unnumbered Parish and Lobb collections from "on limestone rocks" at Moulmein, Burma. Kanjilal and his associates (1939) cite only the Wallich collection from 2000 feet altitude in the Khasi Hills and notes "No specimen in the Forest Herbarium, Shillong; imperfectly known."

The subterminal style, subverticillate inflorescence ramifications, and other unusual characters lead me to wonder if the species may not actually belong in the *Lamiaceae*.

A key to distinguish it from the other known taxa in Assam which are definitely in *Clerodendrum* will be found under C. *griffithianum* C. B. Clarke in the present series of notes [60: 134--136].

Pételot found what he supposed to be this species growing at 1500 m. altitude, in flower in August, in Vietnam.

Hemsley's original (1900) description of C. *subscaposum* is: "Species habitu distinctissima. Caulia primarius subcarnosus vel crassus

et mollis, ut videtur prostratus, cortice laxo deciduo; caules (vel scapi) floriferi, erecti, graciles, circiter sesquipedales, laeves, glabri, infra medium foliis 2 sessilibus parvis ovatis instructi, cetera nudi. Folia longe petiolata, erecta, tenuia, fere membranacea, rotundatocordata, sinu angustissimo, absque petiolo 5--6 poll. longa, acuminata, obscure irregulariterque dentata, supra hispidula, subtus glabrescentia pallidiora vel colorata, venis primariis sat conspicuis; petiolo crassi, usque ad 10 poll. longi. Flores caerulei (fide Henry), absque staminibus 4--5 lin. longi, in paniculam angustam laxam terminalem dispositi; paniculae ramuli subverticillati pauciflori; pedicelli capillares. Calyx hemisphaericus, dentibus brevibus rotundatis. Corolla tubus brevis, limbi lobis ovato-oblongis obtusis. China: Mountains south-east of Mengtze, Yunnan, at 7000 ft. *A. Henry 9181*. The only specimen of this plant does not bear fully expanded flowers, but it is so different in habit from anything else we know that it was considered worth figuring."

P'ei (1932) cites only the type collection, giving the species' distribution as "Tonkin, (Chapa), Khasia", and commenting that "This species is characterized by its very long floral branches which are up to about 45 cm. long, and its long petiolate basal leaves." He cites the Hemsley (1900) reference as "1901".

The *Clerodendron macrostachyum* of Baker, referred to (above) as a homonym, is a synonym of *C. aurantiacum* J. G. Baker.

Citations: INDIA: Assam: *Hooker f. & Thomson 34* (L, N, Pd, V). CHINA: Yünnan: *A. Henry 9181* (N, N--photo). VIETNAM: Tonkin: *Pételot 3117* (N, W--1597336). MALAYA: Singapore: *Lobb 361* (L--isotype, N--photo of isotype). MOUNTED ILLUSTRATIONS: P'ei, Mem. Sci. Soc. China 1 (3): pl. 24. 1932 (Ld).

CLERODENDRUM MACROSTEGIUM Schau. in A. DC., Prodr. 11: 666 [as "*Clerodendron*"]. 1847; Mold., Alph. List Comm. Vern. Names [1], 2, 4, 17, 19, 22, & 24. 1939.

Synonymy: *Volkameria grandiflora* Blanco, Fl. Filip., ed. 1, 512--513. 1837. *Clerodendron macrostegium* Schau. in A. DC., Prodr. 11: 666. 1847. *Clerodendron grandiflorum* Blanco ex H. J. Lam, Verbenac. Malay. Arch. 318. 1919 [not *C. grandiflorum* Gürke, 1983, nor (Hook.) Schau., 1847, nor Salisb., 1795, nor Schau., 1876]. *Clerodendron grandiflorum* H. Lam apud E. D. Merr., Enum. Philip. Flow. Pl. 3: 403 in syn. 1923. *Clerodendrom macrostegium* Schau. ex Mold., Résumé 259 in syn. 1959. *Clerodendron barbatum* Wall., in herb.

Bibliography: Blanco, Fl. Filip., ed. 1, 512--513 (1837) and ed. 2, 357. 1845; Schau. in A. DC., Prodr. 11: 657 & 666. 1847; Buek, Gen. Spec. Syn. Candoll. 3: 106 & 502. 1858; Miq., Fl. Ned. Ind. 2: 875--876 & 883. 1858; Miq., Ann. Mus. Bot. Lugd.-Bat. 3: 253. 1867; Blanco, Fl. Filip., ed. 3, 2: 295. 1878; Fern.-Villar & Naves in Blanco, Fl. Filip., ed. 3, 4: Nov. App. 160--161. 1880; Vidal y Soler, Phan. Cuming. Philip. 56 & 135. 1885; Vidal, Rev. Pl. Vasc. Filip. 211. 1886; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 561. 1893; Briq. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, 4 (3a): 175. 1895; Guerrero, Med. Pl. Philip. 1: 360. 1903; E. D. Merr., Philip. Journ. Sci. Bot. 2: 99.(1912) and 11: 310. 1916; H.

Hallier, Meded. Rijks Herb. Leid. 37: 71 & 76. 1918; E. D. Merr., Sp. Blanc. 334. 1918; H. J. Lam, Verbenac. Malay. Arch. 263, 318, 363, & 364. 1919; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 76, 87--88, 109, & ix. 1921; Guerrero, Philip. Bur. For. Tech. Bull. 22: 330. 1921; Mold., Alph. List Comm. Vern. Names [1], 2, 4, 17, 19, 22, & 24. 1939; Mold., Prelim. Alph. List Inv. Names 20 & 53. 1940; Mold., Alph. List Inv. Names 17 & 56. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 62, 66, & 90. 1942; Mold., Phytologia 2: 100. 1945; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 561. 1946; Mold., Alph. List Cit. 1: 131, 136, 141, & 225. 1946; Mold., Alph. List Inv. Names Suppl. 1: 5 & 6. 1947; Mold., Alph. List Cit. 3: 727 & 894 (1949) and 4: 1223. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 141, 148, & 182. 1949; Quisumb., Philip. Dept. Agr. Tech. Bull. 16: 790. 1951; Mold., Résumé 165, 183, 190, 199, 259, 264, 266, 392, & 451. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 561. 1960; Mold., Résumé Suppl. 3: 28. 1962; Neal, Gard. Hawaii, ed. 2, 731. 1965; Mold., Fifth Summ. 1: 282, 316, 322, 332, 359, 438, 446, & 450 (1971) and 2: 733 & 869. 1971; Mold., Phytol. Mem. 2: 272, 306, 313, 322, 350, & 539. 1980; H. N. & A. L. Mold. in Dassan. & Fosb., Rev. Handb. Fl. Ceyl. 4: 418 & 444. 1983; P. Holmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 58: 208 & 448 (1985), 60: 131 (1986), 61: 25 & 413 (1986) and 61: 468. 1987.

An erect, hairy shrub, 2--5 m. tall, or small tree, 10--20 m. tall, often growing in masses; trunk straight, 3.5--10 cm. in diameter; branches glabrous; bark white; branchlets tetragonal, strigose-tomentose, eventually glabrous; leaves decussate-opposite, somewhat unpleasantly odorous; petioles short, 2.5--3.5 cm. long, with a small gland at the base, strigose-tomentose; leafblades membranous, large, blue-green when fresh, broadly ovate, about 22 cm. long, 15 cm. wide, apically acuminate, marginally entire or abundantly sharp-serrate, basally subcordate or truncate to rounded, somewhat shiny and strigose-puberulent to glabrescent and rugose above, pale and pubescent beneath, finely and densely glandular-punctate; inflorescence axillary and terminal, paniculate or subumbelliform, compact; bracts and bractlets large, foliaceous, the outer ones largest, broadly ovate, subsessile, the upper ones oblong or lanceolate, apically long-acuminate, subequaling the corollas, mostly lilac or purplish, sometimes white; calyx tubular, light-green or bright-pink, showy, about 1.6 cm. long, externally sericeous, apically spreading, 5-veined, 5-fid halfway or almost to the base, the lobes subulate-lanceolate or lanceolate, apically cuspidate, lilac-tinted; corolla hypocrateriform, white or purplish, the tube slender, about 3 cm. long, about twice as long as the calyx, sericeous-subvillous, the limb 5-parted, 2-lipped, spreading, about 1.2 cm. wide, the lobes subequal, oblong or ovate, about 6 mm. long, apically obtuse; stamens 4, didynamous, inserted in the corolla-throat; style filiform; stigma bifid; ovary semiglobose, seated on a striate disk; fruiting-calyx incrassate, subcarnose, reflexed, white or purplish; fruit drupaceous, at first green, later blue to very deep-blue, apically depressed, 4-ribbed, 4-celled, each cell 1-seeded.

This species is based on *Cuming 1541* from somewhere in the Philippine Islands, probably from Luzon. Schauer (1847) notes that: "Species omni notá perinsignis". He cites only the type collection, of which he says that he saw dried (herbarium) material in the Berlin and Lucae herbaria.

Collectors have found C. *macrostegium* growing on mountainsides, in forests, open and secondary forests, thickets and open thickets, damp places in abaca plantations, and secondgrowth on riverbanks, at 100--650 m. altitude, in flower from November to January, March to July, and September, and in fruit in January, March, April, September, and December.

Merrill (1923) lists it from Luzon, Mindoro, Panay, and Sibuyan in the Philippines, as well as from Amboina, Ceram, and Saparua in the Moluccas.

The corollas are described as being "whitish" by Neal (in litt.), "white" on *Kornassi 801, Pijl 720, Ramos, Philip. Bur. Sci. 46361, Robinson 1864, Santos 545,* and *Sulit 4057,* "white, tinged purple" on *Pancho 1024,* "pale-purple" on *Bartlett 13595,* and "dark-purple" on *Santos 8218.*

The boiled leaves of this plant are said to be "famous" as a cancer cure, applied as a tepic decoction and plaster. Sulit asserts - and is supported by Neal in this assertion - that the plant is highly suitable for ornamental planting.

Common and vernacular names recorded for this species are "agboligan", "agbolígan", "aktolígan", "bagáuak", "bagavac", "baúgak", "casopanguil na puti", "kasopáñgil-na-putí". "kopa", "magbolígan", "malapotocan", "nagboligan", "nakbolígan", "payi-payi", "saling-ouac", and "volcameria de flores grandes".

Blanco's original (1837) description of *Volkameria grandiflora* is: "Tronco derecho, con las ramas blancas, y lampiñas. Hojas opuestas, aovadas alargadas, enteras lampiñas, y rugosas. Peciolos cortos, con una glandulilla en la base. Flores enpanoja umbelada. Involucro de la umbelita, dos hojuelas alesnadas. Propio de la florecita, dos hojuelas alesnadas y revueltas acia abajo. Cal. derecho cilindrico, hendido mui profundamente en cinco partes lanceoladas. Cor. fija en el centro del calix, y dos veces mas larga que el, bilabiada, dividida en cinco partes ovales concavas, revueltas acia abajo, y la una á un lado. Estam. cuatro, fijos cerca de la garganta de la corola: los dos mas largos. Ant. hendidas en dos partes, divergentes. German emisferico, asentado sobre una zona estriada. Estilo linear. Estigma bifido. Baya jugosa deprimida, con cuatro angulos redondeados, cuatro aposentos y en cada uno semilla huesosa: algunas abortan y á veces queda solamente una ó dos. = Arbolito de tres varas, y que se hace grueso como el muslo. Las hojas son de color entre verde, y azul: el olor es algo fastidioso. Le he visto en muchos lugares. Sus hojas maceradas en agua dan un color azul mediano, pero fugaz. Flor. en Ag. * T, Malapotocan, Bagavac. Y, Agboligan, Nagboligan. Nota. Hai otra especie mui comun y conocida con las hojas dentadas aserradas. Este es precisamente la que tiene gran fama en Ylocos para la curacion del cancro. Para esto se lava la parte enferma con el cocimiento tibio de las

hojas, y despues se aplican estas en emplasto. Las ramas son lisas y blanquecinas. * T, Bagavac. Y, Agboligan, Nagboligan."

Fernandez-Villar & Naves (1880) say: "*Volkameria* (sp.) foliis dentato-serratis, Blanco ll. cc. Stirps polymorpha, foliis (praeter basim et apicem) junioribus grossè dentatis aut dentato-serratis, adultis integerrimis; floribus axillaribus et terminalibus; paniculis laxè aut densè floriferis. A *C. Infortunato* Linnaei vix ac nec vix differe videtur. Vulgatissima ad Manilam. V. v. sp. in Luzon, Joló et Basilan. (*Cuming n. 1591*). V. -- Saling-ouac."

Merrill (1918) notes that the reduction of Blanco's *Volkameria grandiflora* to *Clerodendrum macrostegium* was first made by Fernandez-Villar "and is certainly the correct disposition of Blanco's species. The specific name *grandiflorum* is invalidated [precluded] in *Clerodendron* by *C. grandiflorum* Schauer and *C. grandiflorum* Salisb. Illustrative specimen from Santa Inez, Rizal Province, Luzon, November, 1916 (Merrill: Species Blancoanae No. *1026*)." This cited collection exhibits abundantly sharp-serrate leafblades. Of his no. *286* he says "the entire inflorescence, including the bracts, pale-purple."

Miquel (1858) was of the opinion that *Volkameria grandiflora* Blanco was conspecific with *Clerodendron capsulare* Blanco, which is now regarded as a synonym of *C. inerme* (L.) Gaertn. Hallier (1918) placed it in the synonymy of *C. minahassae* Teijsm. & Binn.

The *C. grandiflorum* accredited to Gürke in the synonymy (above) is a synonym of *C. excavatum* DeWild., *C. grandiflorum* Salisb. is a synonym of *C. serratum* (L.) Moon, and *C. grandiflorum* Schau. is *C. grandiflorum* (Hook.) Schau., which see.

Keys to help distinguish *C. macrostegium* from other Indonesian taxa will be found under *C. klemmei* Elm. in the present series of notes [61: 410--415] and from other taxa cultivated in the Hawaiian Islands under *C. indicum* (L.) Kuntze [61: 23--25].

Hallier (1918) comments that "Diese von Schauer zu den *Densiflora* gestellte Art gehört ganz zweifellos in die Verwandschaft des *Cl. villosum* Bl. und der ihm oben folgenden Arten" in Section *Paniculata*. He cites *Reinwardt 1464* from Saparua, *DeVriese & Teijsmann s.n.* from Ceram, *Elmer 12161* from Romblon, and *Cuming 1541* from Luzon, Philippine Islands. Merrill (1923) cites from the Philippines *Ahern's Collector 3330, Cuming 1541, Elmer 12161, Kobbe, Herb. Philip. For. Bur. 6697, Loher 6573, Mangubat, Herb. Philip. Bur. Sci. 936, Merrill 886, 1244, 1260, 1860,* & *Sp. Blanc. 1026,* and *Merritt 3707* & *9957.* The *Loher 4421* collection is said to be a perfect match for *Vidal 1650.*

Material of *Clerodendrum macrostegium* has been misidentified and distributed in some herbaria as *C. brachyanthum* Schau., *C. bracteatum* Wall., *C. fragrans* Vent., *C. multibracteatum* Merr., and *C. viscosum* Vent. On the other hand, the *Aguilar, Herb. Philip. For. Bur. 20165,* distributed as *C. macrostegium,* actually is *C. brachyanthum* Schau., while *Sallnam 81* is *C. lanuginosum* Blume and *Merrill 799* is *C. viscosum* Vent.

Citations: BURMA: Upper Burma: *D. J. Anderson s.n.* [Bhamo, 10 February '68] (Bz--20934, Bz--20935). PHILIPPINE ISLANDS: Luzon:

Ahern's Collector, Herb. Philip. For. Bur. 450 (N, W--851209), *3330* (Bz--20017, N, W--708425); *Cuming 1541* (L--isotype, L--isotype, M--isotype, Mu--1406--isotype, X--isotype); *Edaño, Herb. Philip. Bur. Sci. 48723* (Ca--321767, N); *F. C. Gates 8413* (Mi); *Kienholz 186* [Herb. Philip. Bur. Sci. 16256] (Ca--263056); *Loher 4421* (W--446870), *6573* (Mu--4183), *6595* (Mu--4184), *13371* (Mu--4344); *E. D. Merrill 1860* (N, W--436812), *Sp. Blanc. 1026* (Bz--20015, N, W--904713; *Quisumbing, Herb. Philip. Bur. Sci. 76621* (N); *M. Ramos, Herb. Philip. Bur. Sci. 8143* (N). Mindoro: *Bartlett 13595* (Mi); *T. Cruz 91* (Ur); *Mangubat, Herb. Philip. Bur. Sci. 936* (Bz--20014, N, W--439744); *E. D. Merrill 886* (E--118828, N, W--435854), *1244* (W--436215), *1280* (W-436249), *Dec. Phil. For. Fl. 286* (Ca--70115, Du--9531, Mi, Os, W--1584128); *M. Ramos, Herb. Philip. Bur. Sci. 46361* (Bz--20013, Ca--309557, N); *J. V. Santos 545* (Mi), *8218* (W--2246513); *Sulit, Philip. Nat. Herb. 13770* (A), *13772* (A, W--2188151). Romblon: *Elmer 12161* (Bi, Bz--20016, L, N, Ut--28991, Vt, W--917598). GREATER SUNDA ISLANDS: Java: *Roepke s.n.* [21/8/1918] (Bz--20925). MOLUCCA ISLANDS: Amboina: *Pijl 720* (Bz--20002, Bz--20003); *C. B. Robinson 1864* (Bz--20004, N, W--775250). Ceram: *Buwalda 5930* (Bz--72957); *Kornassi 29* (Bz--20009, Ca--236048, Ut--80795), *801* (Bz--20005, Bz--20006, Ca--265983, Ut--80828); *Rutten 129* (Bz--20010, Ut--80796); *Teijsmann 5075* (Bz--20008, Ut--11579), *s.n.* [Wahaai, Augustus] (Bz--20007); *Treub s.n.* [1893] (Bz--20011). CULTIVATED: Hawaiian Islands: *Potter FL.91* (Mi). Philippine Islands: *Pancho 1024* (Ba).

CLERODENDRUM MADAEERA (Roxb.) Voigt, Hort. Suburb. Calcutt. 467 [as "*Clerodendron*"]. 1845; Mold., Phytologia 50: 267. 1982.

Synonymy: *Volkameria madoeera* Roxb., Hort. Beng., imp. 1, 46 nom. nud. 1814. *Clerodendron madaeera* (Roxb.) Voigt, Hort. Suburb. Calcutt. 467. 1845. *Volkameria madaeera* Roxb. apud Voigt, Hort. Suburb. Calcutt. 467 in syn. 1845. *Clerodendron madaeera* Voigt apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 561. 1893.

Bibliography: Roxb., Hort. Beng., imp. 1, 46. 1814; Voigt, Hort. Suburb. Calcutt. 467. 1845; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 561 (1893), imp. 1, 2: 1219 (1895), imp. 2, 1: 561 (1946), imp. 2, 2: 1219 (1946),, imp. 3, 1: 561 (1960), and imp. 3, 2: 1219. 1960; Mold., Fifth Summ. 2: 733, 869, & 969--971. 1971; Mold., Phytol. Mem. 2: 259, 350, 387, & 539. 1980; Roxb., Hort. Beng., imp. 2, 46. 1980; Mold., Phytologia 50: 267. 1982.

Roxburgh (1814) says of this taxon merely "Madoeera. H. Madoear. Cawnpore. Coll. Hardwicke, 1800". Voigt (1845) says: "Cawnpore. Was introduced into H. C. G. in 1800, but had not fl. up to 1814".

Nothing is known to me of this plant save what is stated in its meager bibliography (above). As far as I know, it has not been disposed of in any way by any previous writer.

CLERODENDRUM MADAGASCARIENSE Mold., Phytologia 3: 313. 1950.

Synonymy: *Clerodendron ternifolium* J. G. Baker, Journ. Linn. Soc. Lond. Bot. 20: 229. 1883 [not *Clerodendrum ternifolium* H.B.K., 1817, nor *Clerodendrum ternifolia* D. Don, 1825].

Bibliography: H.B.K., Nov. Gen. Sp. Pl. 2: 244. 1817; D. Don,

Prodr. Fl. Nep. 103. 1825; J. G. Baker, Journ. Linn. Soc. Lond. Bot. 20: 229. 1883; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 562 (1893) and imp. 2, 1: 562. 1946; Mold., Phytologia 3: 313. 1950; E. J. Salisb., Ind. Kew. Suppl. 11: 56. 1953; Mold. in Humbert, Fl. Madag. 174: 152, 205, 208--209, 266, 268, & 269, fig. 33 (5). 1956; Mold., Résumé 155, 270, & 451. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 562. 1960; Mold., Résumé Suppl. 16: 20. 1968; Mold., Fifth Summ. 1: 260 & 457 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 249 & 539. 1980; H. N. & A. L. Mold. in Dassan. & Fosb., Rev. Handb. Fl. Ceyl. 4: 418. 1983; Mold., Phytologia 58: 188. 1985.

Illustrations: Mold. in Humbert, Fl. Madag. 174: 205, fig. 33 (5). 1956.

An erect shrub, 1.5 m. tall, or small tree; branches and branchlets apparently rather virgate, grayish, obtusely tetragonal, minutely puberulent, conspicuously lenticellate with longitudinally elongated, corky lenticels, the ultimate branchlets long, woody, simple, slender, and straight; nodes annulate; principal internodes 1--5.5 cm. long, mostly abbreviated; leaves ternate, numerous, ascending, short-petiolate; petioles very slender, 4--9 mm. long, minutely puberulent; leafblades membranous, rather firm-textured, bright-green on both surfaces, often brunnescent in drying, narrowly elliptic, varying to lanceolate or oblanceolate, 3.3--7.5 cm. long, 1--1.5 cm. wide, apically gradually narrowed to the blunt or acute apex, marginally entire, basally attenuate-acute, minutely puberulent on both surfaces or glabrescent (except for the midrib) above; midrib very slender, flat above, prominulous beneath; secondaries very slender, 5--10 per side, flat above, slightly subprominulous beneath, irregular, mostly short, arcuately joined near the margins beneath, mostly obscure or indiscernible above; veinlet reticulation sparse, indiscernible above, the largest portions often visible beneath; inflorescence axillary and terminal, loosely many-flowered, usually in the form of flat-topped panicles at the ends of the long branchlets, the individual cymules most often 3-flowered, stipitate, minutely puberulent throughout; bractlets lanceolate or linear, the uppermost ones in the terminal inflorescences often more or less foliaceous, puberulent, the ultimate ones linear-setaceous; pedicels slender or filiform, 2--8 mm. long, puberulent; calyx chartaceous, campanulate, 1.3--2.2 cm. long, 9--12 mm. wide, very sparsely and minutely strigillose or glabrescent, longitudinally venose, the rim deeply 5-lobed, the lobes ovate or deltoid, 4--7 mm. long, apically acute, erect; corolla infundibular-hypocrateriform, rose or wine-red, the tube broadly cylindric, 2--2.5 cm. long, 2.5--4 mm. wide, apically gradually ampliate, externally very sparsely puberulent, the limb to 2 cm. wide; stamens and pistil exserted 1--1.5 cm. from the corolla-mouth; ovary small, globose.

Baker (1883) refers to this plant, apparently rather inaccurately, as "An erect tree, glabrous in all its parts". It is based on *Baron 1680* from central Madagascar, collected in or before October of 1882 and deposited in the Kew herbarium. Baker comments that it is "Allied to C. *arenarium* and C. *laxiflorum*". Collectors have encountered it at the edges of rivers, at 1000 m. altitude, in anthe-

sis in September and October.

The *Clerodendrum ternifolium* of Humboldt, Bonpland, and Kunth, referred to in the synonymy (above), is a valid South American species, while that of Don is a synonym of *C. serratum* (L.) Moon, which see.

A key to help distinguish *C. madagascariense* from other Madagascar taxa will be found under *C. baronianum* Oliv. in the present series of notes [58: 184--190].

Citations: MADAGASCAR: *Baron 1680* (E--photo of type, F--photo of type, K--type, Ld--photo of type, N--photo of type, P--isotype), *1681* (P); *Decary 5228* (P), *5882* (N, P).

CLERODENDRUM MAGNIFICUM Warb., Engl. Bot. Jahrb. 10: 428 [as "*Clerodendron*"]. 1890; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 67 & 90. 1942.

Synonymy: *Clerodendron magnificum* Warb., Engl. Bot. Jahrb. 10: 428. 1890.

Bibliography: Warb., Engl. Bot. Jahrb. 10: 428. 1890; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 525. 1900; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 101. 1901; Pulle in Lorentz, Nova Guinea, ser. 1, 8: 402--403 (1910) and ser. 1, 8: 687. 1914; H. J. Lam, Verbenac. Malay. Arch. 273 & 364. 1919; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 77, 94, 109, & ix. 1921; H. J. Lam in Lauterb., Engl. Bot. Jahrb. 59: 96. 1924; Bakh. in White, Journ. Arnold Arb. 10: 264. 1929; Bakh., Journ. Arnold. Arb. 10: 73--74. 1929; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 2, 101. 1941; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 67 & 90 (1942) and ed. 2, 149 & 182. 1949; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 3, 101. 1959; Mold., Résumé 200, 202, & 451. 1959; Mold., Fifth Summ. 1: 335 & 338 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 325, 328, & 539. 1980; Mold., Phytologia %@: 31 (1982), 59: 472 (1986), and 61: 415. 1986.

A small bush or large, fleshy, glabrous shrub, 1.5--3 m. tall; stems tetragonal, not inflated, rather smooth, the young parts red-purple; leaves decussate-opposite, rather variable in size and form; petioles thick, 2--7 cm. long, glabrous, purple-red; leafblades large, membranous, sappy, broadly ovate, 22--28 cm. long, 14--18 cm. wide, apically short-acuminate, marginally entire, basally rounded or subacuminate, dark glossy bright-green above and with purple impressed veins or entirely purplish-green, paler green beneath, 3- or 5-plinerved, glabrous; secondaries about 6 per side, ascending at a rather acute angle, sharply prominent and red-purple beneath, anastomosing in loops near the margins; inflorescence terminal, a panicle-like thyrse, trichotomous, 15--20 cm. long and almost equally wide, shorter than the upper leaves, red and glabrous throughout, the ramifications 3--6 cm. long; bracts and bractlets foliaceous, very variable in size and shape, red, mostly lanceolate or obovate, 1--2 cm. long; pedicels about 5 mm. long, red; calyx large, red, inflated, 2--2.5 cm. long, 1.5--3 cm. [fide Warburg; =mm.], 5-angled, 5-lobed, the lobes unequal, ovate, 2--12 mm. long, apically acute; corolla hypocrateriform, salmon-pink to red or

scarlet, the tube equaling the calyx, 2.5 cm. long, 2 mm. wide, the lobes obovate, spreading, subequaling the tube, apically obtuse, basally attenuate; stamens long-exserted; filaments red, about 10 cm. long, 3--4 times as long as the corolla-tube; style filiform, 8 cm. long, slightly shorter than the stamens, red; stigma bifid, the branches 1 mm. long; fruit drupaceous, included by the fruiting-calyx when immature, globose, 1 cm. long and wide, orange-yellow, by abortion producing 2--4 pyrenes.

Warburg (1890) comments that "Durch die prächtig rot gefärbte Inflorescenz mit den ebenso gefärbten grossen Kelchen, Bracteen, Blütenstielen, Staubgefässen und Griffeln, ferner durch die saftig grünen Blätter ist diese Pflanze eine der schönsten Zierden des Gipfelwaldes des Sattelberges und wohl zu gleicher Zeit die schönste Pflanze, die bisher von Neu-Guinea bekannt geworden ist. Ohne Zweifel wird sie bald eine beliebte Gewächshauspflanze bei uns sein, d. h. wenn der Wuchs sich in mässigere Dimensionen wird lenken lassen können.

"Indurch den Mangel an Behaarung und den grossen, gefärbten Kelch unterscheidet sich die Art von allen *Clerodendron*arten derselben Gruppe (nämlich der Section *paniculata* [sic] DC., Prodr. Xi. p. 666), sie steht aber der *Cl. Bethunianum* Lowe aus Sarawak in Nordborneo (Curtis, Regist. t. 4485, Hook., Bot. Mag. Compan. 1848. p. 74) nahe, unterscheidet sich aber durch grössere Kelche und Blüten, durch den Mangel der Schuppen auf den Blattunterseite, durch die unverzähnten, an der Basis nicht herzförmigen Blätter und anders mehr. Da aber diese Art sich in den Warmhäusern gut als kleinere Pflanze kultiviert lässt, obgleich sie in Borneo 10' hoch wird, so darf man es bei unserer Art gleichfalls hoffen."

Bakhuizen (1929) notes that this is "A beautiful species, which up to now is known only from New Guinea and spreads apparently over the whole island on [sic] low country."

Collectors have found *Clerodendrum magnificum* growing in woods and dense high forests, forest clearings, and along streamsides, at 80--2550 m. altitude, in flower in May, June, and September to December, and in fruit in March. The plant is described by Darbyshire as "common on the floor of tall rainforests".

The corollas are described as "red" on *Aet & Idjan 816* and *Kanehira & Hatusima 12412*, "light-red" on *Kaernbach 69*, "scarlet" on *Darbyshire 848*, and "salmon" on *Brass 680*.

Vernacular names reported for the species are "maipa" and "mangakafeh".

A key to help distinguish the species from other Indonesian taxa in this genus will be found under *C. klemmei* Elm. in the present series of notes [61: 410--415].

The Warburg description (1890) is cited by Durand & Jackson (1901) as "1891", the volume titlepage date.

The MacGregor collection, cited below, is a mixture with *C. friesii* K. Schum.

Schumann & Lauterbach (1900) cite *Hellweg 239* & *525* and *Kaernbach 69*; Pulle (1910) cites *Versteeg 1732* from West Irian but notes that this collection differs somewhat from the typical form in its some-

what smaller leaves. In his 1914 work he cites *Gjellerup 216* and *Von Römer 501* & *593*; Lam (1924) cites *Kaernbach 69* and *Schlieben 16895*; Bakhuizen (1929) cites *Brass 680* & *1129*. All these collections are from New Guinea.

Citations: NEW GUINEA: Papua: *Brass 680* (Bz--20019), *1129* (Bz--20020); *Chalmers s.n.* [S.E. New Guinea 1878] (Mb); *Darbyshire 848* (Ba); *Loria & Giulianetti s.n.* [Novembre 1882] (Mb); *W MacGregor s.n.* [Camp 1, 1889] (Mb), *s.n.* [5/6/89] (Mb). Territory of New Guinea: *Hellwig 239* (Bz--20022); *Schlechter 16895* (Ca--226500). West Irian: *Gjellerup 216a* (Bz--20023); *Kanehira & Hatusima 12412* (Bz--20018); *Versteeg 1732* (Bz--20021, Bz--25531, Ld--photo, N--photo, Ut--13809). NEW GUINEAN ISLANDS: Japen: *Aet & Idjan 816* (Bz--72745). Saibai: *C. H. Hartmann s.n.* [1885] (Mb).

CLERODENDRUM MAGNOLIAEFOLIUM J. G. Baker in Trimen, Journ. Bot. Brit. 20: 243 [as "*Clerodendron*"]. 1882; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 53 & 90. 1942.

Synonymy: *Clerodendron magnoliaefolium* J. G. Baker in Trimen, Journ. Bot. Brit. 20: 243. 1882.

Bibliography: J. G. Baker in Trimen, Journ. Bot. Brit. 20: 243. 1882; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 561. 1893; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 53 & 90. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 561. 1946; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 123 & 182. 1949; Mold. in Humbert, Fl. Madag. 174: 151, 193, 196--197, 266, & 268, fig. 31 (8). 1956; Mold., Résumé 155 & 451. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 561. 1960; Mold., Fifth Summ. 1: 260 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 249 & 539. 1980; P. Holmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 58: 187. 1985.

Illustrations: Mold. in Humbert, Fl. Madag. 174: 193, fig. 31 (8). 1956.

A shrub or tree, 3--8 m. tall; branchlets and twigs rather slender, gray, lenticellate, glabrous, often shiny; nodes not annulate; principal internodes 2--5 cm. long, or sometimes more abbreviated on twigs; leaves decussate-opposite; petioles rather stoutish, flat or canaliculate above, 2--14 mm. long, glabrous; leafblades subcoriaceous, uniformly bright-green and shiny on both surfaces, elliptic or oblanceolate, 3--11.5 cm. long, 1.5--4 cm. wide (mostly 3.5--7.5 cm. long and 4.5 cm. wide), apically rounded or subacute, marginally entire, often revolute in drying, basally attenuate or acuminate, glabrous on both surfaces; midrib slender, flat above, sharply prominent beneath; secondaries slender, 4--15 per side, divergent at almost right angles or slightly ascending, arcuately joined several mm. from the margins, varying from obscure to subprominulous above, prominulent beneath; veinlet reticulation mostly sparse and obscure, rarely prominulent above; inflorescence axillary, mostly borne at the tips of the twigs, the cymes mostly few-flowered but sometimes aggregated into small panicles, nigrescent throughout; lateral peduncles elongated to 4.5 cm., glabrous, shiny, those at the base of the panicles usually much abbreviated; pedicels stout, nigrescent,

1.5--2 cm. long, glabrous; foliaceous bracts absent; bractlets linear, 4--8 mm. long, glabrous; calyx coriaceous, tubular, green when fresh, nigrescent in drying, not venose, 2.3--3.5 cm. long, 1--1.6 cm. wide, glabrous, the rim 5-lobed, the lobes 5--6 mm. long. apically acute or obtuse; corolla infundibular, violet or rose to white with a rosy throat, the tube broad, barely equaling the calyx, about 5 mm. wide, glabrous, the rim 5-lobed, to 3.5 cm. wide, the lobes broadly elliptic, 13--15 mm. long, about 10 mm. wide, apically rounded; stamens exserted about 2 cm. from the mouth of the corolla-tube, reddish; anthers reddish-yellow; pistil reddish.

This endemic species is based on *Baron 93*, collected somewhere in Madagascar before June 1889 and deposited in the Kew herbarium.

Collectors have encountered this plant in shady river forests, 800--1000 m. altitude, in flower in February and November.

The corollas are said to have been "rose"-color on *Decary 17526*, "violet" on *Hildebrandt 3899*, and "white, the throat rose" on *Cours 981*.

It should be noted here that in my 1956 work, through a typographic error, the length of the calyx-lobes is given as "5--6 cm." long, instead of 5--6 mm.

A key to help distinguish this species from other Madagascar taxa will be found under *C. baronianum* Oliv. in the present series of notes [58: 184--190].

Citations: MADAGASCAR: *Baron 93* (E--photo of isotype, F--photo of isotype, Ld--photo of isotype, N--isotype, N--photo of isotype, P--isotype); *Cours 981* (P); *Decary 17526* (P); *Hildebrandt 3899* (N, P); *Humbert & Cours 17647* (P); *Ursch 3* (N, P).

CLERODENDRUM MAKANJANUM H. Winkler, Feddes Repert. Spec. Nov. 18: 124 [as "*Clerodendron*"]. 1922; B. Thomas, Engl. B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 48, 88, & 94. 1936 [not C. *makanjanum* "sensu Meeuse", 1960].

Synonymy: *Clerodendron makanjanum* H. Winkler, Feddes Repert. Spec. Nov. 18: 124, 1922. *Clerodendrum mekanjanum* H. Winkler ex Mold., Known Geogr. Distrib. Verbenac., ed. 1, 49 & 90 sphalm. 1942. *Clerodendron makajanum* Winkler apud Anon., U. S. Dept. Agr. Bot. Subj. Ind. 15: 14356 sphalm. 1958. *Clerodendron fragile* Peter ex Mold., Resume 263 in syn. 1959.

Bibliography: H. Winkler, Feddes Repert. Spec. Nov. 18: 124. 1922; A. W. Hill, Ind. Kew. Suppl. 7: 51. 1929; Fedde & Schust., Justs Bot. Jahresber. 53 (1): 1072. 1932; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 48, 88, & 94. 1936; Brenan & Greenway, Tangan. Terr. Check-list 2: 631. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 49 & 90 (1942) and ed. 2, 116 & 182. 1949; Brenan, Check-list Trees Shrubs Tangan. 2: 631. 1949; Anon., U. S. Dept. Agr. Bot. Subj. Ind. 15: 14356. 1958; Meeuse in Dyer, Flow. Pl. Afr. 32: pl. 1274. 1958; Anon., Assoc. Étud. Tax. Fl. Afr. Trop. Ind. 1958: 64. 1959; Meeuse, Excerpt. Bot. A.1: 213. 1959; Mold., Résumé 144, 153, 263, & 451. 1959; Mold., Résumé Suppl. 1: 9, 10, 16, & 25. 1959; Wild & Gelfand, Cent. Afr. Journ. Med. 5: 292--305. 1959; Gillett, Kew Bull. 14: 342--344. 1960; Anon., Assoc. Étud. Tax. Fl.

Afr. Trop. Ind. 1960: 60. 1961; Dale & Greenway, Kenya Trees Shrubs 583 & 585. 1961; Townsend, Excerpt. Bot. A.3: 127. 1961; Mold., Résumé Suppl. 13: 4 (1966) and 15: 19. 1967; Greenway, Journ. East Afr. Nat. Hist. Soc. Nat. Mus. 27: 196. 1969; Gillett, Numb. Check-list Trees Kenya 46. 1970; Mold., Fifth Summ. 1: 236, 245, 247, 249, 251, 256, 445, 463, 465, & 466 (1971) and 2: 869. 1971; Farnsworth, Pharmacog. Titles 8 (8): vi. 1973; Jacobsen, Kirkia 9: 172. 1973; Isaacson, Flow. Pl. Ind. 1: 336. 1979; Mold., Phytol. Mem. 2: 225, 230, 235, 237, 238, 240, 245, & 539. 1980; Mold., Phytologia 59: 259 (1986) and 61: 408. 1986.

A weak-stemmed, loosely branched shrub or spreading climber, to 3 m. tall, completely leafless when in flower; stems and branches fleshy, yellow-brown or gray; bark gray; young branchlets white-tomentose, becoming glabrescent; principal internodes 3--6 cm. long; width of last year's stem just below the inflorescence about 1.5 mm.; leaves decussate-opposite, clustered on short twigs, petiolate; leafblades ovate-oblong, to 5 cm. long and 2.5 cm. wide, apically acute or subobtuse, marginally coarsely and irregularly serrate, somewhat fleshy, basally attenuate into the petiole, scattered-pilose beneath, becoming glabrescent; secondaries 3 or 4 per side; inflorescence terminal, spicate-paniculate, 5--15 cm. long; rachis purple, the sympodia to 10 mm. long, glabrous, the lower ramifications 1--2 mm. long; bracts lanceolate; flowers medium-size, pedicellate, zygomorphic, about 1 cm. long; pedicels about 2.5 mm. long; calyx campanulate, 2--3 mm. long, scattered-glandulose, 5-lobed, the lobes mostly broader than long, apically obtuse to rounded-obtuse or rarely acute, glandulose, marginally glandular-ciliate; corolla zygomprphic, pale-mauve or blue and white, externally densely glandulose, the tube short, the lobes declinate, glandular-ciliate, the lip pinkish-purple, the lowest lobe marginally more or less involute but not navicular; stamens erect, arcuate, 10--14 mm. long at time of full anthesis, basally papillose-pilose; anthers 2 mm. long; fruit drupaceous, globose, about 6 mm. long and wide, glandulose when young, soon glabrescent, nervose in drying.

This very characteristic species is based on *Winkler 3797* from the succulent-savanna between Makanja and Same, south of the Pare Mountains, collected on September 1, 1910, and deposited in the Breslau herbarium. Winkler (1922) cites also *Engler 1517* from Tanganyika (Tanzania) and comments that "Die Art, die *C. kissakense* Gürke sehr nahe steht, ist sofort an den wagerecht abspreizenden Seitenzweigen zu erkennen. Die Blätter scheinen stumpfer und von weniger gestreckten Form als bei der Gürkeschen Art zu sein. Die Kelchzipfel decken sich nicht. Der flache, löffelförmige Vorsprung der zwar ± eingerollten, aber nicht kahnförmigen Unterlippe fehlt." It is a member of the Subgenus *Cyclonema*.

Meeuse (1958) gives a lengthy discussion of this species as compared to *C. wildii* Mold: "Dr. H. Wild of the Government Herbarium, Salisbury, Southern Rhodesia, after whom Dr. H. N. Moldenke named his *Clerodendrum wildii*, reported to the National Herbarium, Pretoria, that this species is very close to, if not the same as, *C. makanjanum*. The original material of *C. makanjanum* was destroyed

during the war [World War II], but after a comparison of Winkler's original description of *C. makanjanum* with Moldenke's description of *C. wildii*, and of a topotype of *C. makanjanum* collected by Drummond and Hemsley, kindly sent on loan by the East African Herbarium, Nairobi, with authentic material of *C. wildii* there can be very little doubt that the two names are indeed synonymous" and that *C. wildii* Mold. should be placed in the synonymy of *C. makanjanum*. He comments that Thomas (1936) "mentions an Engler specimen (*No. 1577*) from Usambara, Tanganyika Territory, as the type [of *C. makanjanum*], but this is erroneous because the author of the species had already clearly indicated a specimen that he himself had collected (*Winkler 3797* from near Makanja, Tanganyika in herb, Breslau) as the type by adding 'Original' in the citation. This is still important, although the original specimens are destroyed, for the selection of a type locality, because it makes the Drummond and Hemsley gathering mentioned before a topo-type." Thomas cites only the *Engler 1577* collection and places the species in Section *Stacheocymosa* Thomas in Subgenus *Cyclonema*.

Gillett (1960) has more recently re-examined the two taxa and reports as follows: "A *Clerodendrum* from the Soutpansberg District of the Transvaal has recently been illustrated in 'Flowering Plants of Africa' (t. 1274: 1958) as *C. makanjanum* Winkler, *C. wildii* Moldenke being cited as a synonym. The type of *C. makanjanum* seems to have been destroyed in the 1939-45 War but some ten specimens from NE. Tanganyika and SE. Kenya, an area including the type-locality, which seem to have been correctly identified as *C. makanjanum* have been examined and are found to differ consistently in the characters listed below, from *C. wildii*, which occupies an entirely separate area. In these circumstances it seems clear that *C. wildii* should be retained as a distinct species, at least until experimental evidence is produced that it is freely interfertile with *C. makanjanum*, in which case subspecific status might be appropriate. It may be remarked in passing that a third species, *C. kissakense* Guerke (1900) appears from the description to be closer to *C. wildii* than is *C. makanjanum*." The differences referred to above may be summarized as follows: *C. makanjanum* -- width of last year's stem just below the inflorescence about 1.5 mm.; length of lower inflorescence-branches 1--2 mm.; inflorescence sympodia up to 10 mm. long and glabrous; length of calyx during anthesis about 3 mm.; length of stamens in open flower 10--14 mm.; length of anthers about 2 mm.; and width of fruit about 6 mm. *C. wildii* -- width of last year's stem just below the inflorescence about 2.5 mm.; length of lower inflorescence-branches often up to 3--5 mm.; inflorescence sympodia up to 15 or 20 mm. long, glabrous or more often tomentellous; length of calyx during anthesis 4--6 mm.; length of stamens in open flowers 17--25 mm.; length of anthers about 4 mm.; and width of fruit 8--9 mm. He cites from Kenya for *C. makanjanum* the following: *Bally 8544*, *Dale 3785*, *Drummond & Hemsley 4416*, *Joana in Bally 7500*, and *Ossent 106* and from Tanganyika: *Bally 5750* & *5751*, *Burtt 4920*, *Drummond & Hemsley 2330*, *Engler 1517*, and *Winkler 3766* & *3797*.

The *C. matamanense* Mold. and *C. ribauense* Mold., reduced to C.

makanjanum by me in a previous publication (1971), actually belong to the synonymy of *C. wildii* Mold. The *C. makanjanum* of Isaacson (1979) is also really *C. wildii* as is that reported by me in various previous papers from Zambia, Zimbabwe, Malawi, Mozambique, and South Africa.

Collectors have encountered the true *C. makanjanum* on hillsides and in open woodlands in association with *Markhamia, Pileostigma, Vitex,* and *Strychnos dysophylla.* They describe the plant in the wild as a shrub or a 13-foot tree, the trunk 3 inches in diameter, the bark dark and rough, and the branches brittle. Peter describes the "flowers" (on *no. 8481*) as "green and lilac" and the "Zweige brütig". He also states that the plant "steht immer in Gestrupp, nie allein" and that it differs from *C. kissakense* in its short calyx, shorter and narrower leaves, and shorter internodes, but is obviously related to that species -- his *no. 8481* is entirely leafless.

Clerodendrum makanjanum has been encountered at 700 m. altitude, in flower in February and March. The only vernacular name recorded for it is "munyludeka". The plant is said to be eaten by elephants and to be used by natives in the treatment of epilepsy. A key to help distinguish it from other Kenyan species will be found under *C. discolor* (Klotzsch) Vatke in the present series of notes [59: 259--260].

Greenway (1969) cites from Kenya: *Greenway 9545, Ossent 106,* and *Polhill & Paulo 470.*

The *Barbosa 2473* & *2505, Creek M.117, Hardy 973, Mendonça 902* & *1212, Meeuse 9190, Phillips 2919, Rogers 19251,* and *Torre & Paiva 2019, 9356, 9448,* & *9574,* distributed as *C. makanjanum,* are probably all *C. wildii* Mold.

Citations: TANZANIA: Tanganyika: *Mathias & Taylor A.145* (E--1986690); *Peter 8391* [O.III.35] (B), *8408* [O.III.36] (B, Ld), *8443* [O.III.38] (B), *8481* [O.III.39] (B), *9377* [O.III.63] (B).

CLERODENDRUM MANANJARIENSE Mold., Lloydia 13: 208--209. 1950.

Bibliography: Mold., Lloydia 13: 208--209. 1950; E. J. Salisb., Ind. Kew. Suppl. 11: 56. 1953; Mold. in Humbert, Fl. Madag. 174: 155, 240--242, & 268, fig. 39 (4 & 5). 1956; Mold., Résumé 155 & 451. 1959; Mold., Fifth Summ. 1: 260 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 249 & 539. 1980; P. Holmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 58: 190. 1985.

Illustrations: Mold. in Humbert, Fl. Madag. 174: 241, fig. 39 (4 & 5). 1956.

A shrub or small tree, to 4 m. tall; branchlets and twigs slender, obtusely tetragonal, gray, the youngest parts minutely puverulous, the older parts glabrescent; lead-scars very large and prominent, corky; nodes not annulate; principal internodes 7--20 mm. long; leaves decussate-opposite; petioles very slender, 5--12 mm. long, subglabrate; leafblades membranous, bright-green above, lighter beneath, not nigrescent, elliptic, 1--6 cm. long, 1.8--2.6 cm. wide, apically acuminate, marginally entire, basally acute or acuminate, very obscurely pulverulent-punctate above or glabrate, densely

resinous-punctate beneath; midrib slender, flat above, prominulous beneath; secondaries very slender, 3--8 per side, arcuate-ascending, flat or often obscure above, subprominulent beneath; veinlet reticulation rather sparse, indiscernible above, flat beneath; inflorescence axillary and terminal, the cymes aggregated at the tips of the twigs, loosely many-flowered, minutely puberulent throughout; foliaceous bracts absent; bractlets linear-setaceous; pedicels filiform, 2--4 mm. long, puberulous; calyx campanulate, about 2 mm. long and wide, externally obscurely puberulous or glabrate, nigrescent in drying, the rim subtruncate, minutely denticulate or subentire; corolla hypocrateriform, white or pinkish, the tube narrowly cylindric, 6--8 mm. long, externally minutely pulverulent, the limb about 5 mm. wide; stamens and pistil violet, exserted about 1 cm. from the corolla-mouth; fruiting-calyx and fruit not known.

This endemic species is based on *Perrier 10192* from about 400 m. altitude between Tavy and Savoka, in the vicinity of Mananjary, Madagascar, collected in January of 1913 and deposited in the Paris herbarium. Decary found the plant growing along roadsides in forests, describing it as a small tree, in anthesis in August.

A key to help distinguish this species from other Madagascar taxa in this genus will be found under *C. baronianum* Oliv. in the present series of notes [58: 184--190].

Citations: MADAGASCAR: *Decary 4674* (P); *Perrier 10192* (E--photo of type, F--photo of type, Ld--photo of type, N--isotype, N--photo of type, P--type).

CLERODENDRUM MANDARINORUM Diels, Engl. Bot. Jahrb. 29: 549 [as "*Clerodendron*"]. 1900; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 11. 1936.

Synonymy: *Clerodendron mandarinorum* Diels, Engl. Bot. Jahrb. 29: 549. 1900. *Clerodendron bodinieri* Léveillé, Fedde Repert. Spec. Nov. 9: 325. 1911. *Clerodendron cavaleriei* Léveillé, Feddes Repert. Spec. Nov. 10: 439. 1912. *Clerodendron bodinierii* Léveille apud Fedde & Schust., Justs Bot. Jahresber. 39 (2): 319. 1913. *Clerodendron bodinieri* var. *cavaleriei* Léveillé, Fl. Kouy-Tchéou 441. 1915. *Clerodendron manderinorum* Diels apud P'ei, Sinensia 2: 75. 1932.

Bibliography: Diels, Engl. Bot. Jahrb. 29: 549. 1900; K. Schum., Justs Bot. Jahresber. 28 (1): 495. 1900; Diels, Fl. Cent.-China 549. 1902; Thiselt.-Dyer, Ind. Kew. Suppl. 2: 94. 1904; Léveillé, Feddes Repert. Spec. Nov. 9: 325 (1911) and 10: 439. 1912; Fedde & Schust., Justs Bot. Jahresber. 39 (2): 319 (1913) and 40 (2): 334. 1915; Léveillé, Fl. Kouy-Tcheou 441. 1915; Rehd. in Sarg., Pl. Wils. 3: 375. 1916; Léveillé, Cat. Pl. Yun-Nan 277. 1917; P'ei, Mem. Sci. Soc. China 1 (3): 124 & 145--147. 1932; P'ei, Sinensia 2: 75. 1932; Rehd., Journ. Arnold Arb. 15: 325--326. 1934; Dop in Lecomte, Fl. Gen. Indo-chine 4: 852 & 875--876. 1935; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 11. 1936; Rehd., Journ. Arnold Arb. 18: 286. 1937; Mold., Geogr. Distrib. Avicenn. 37. 1939; Mold., Prelim. Alph. List Inv. Names 21. 1940; Mold., Alph. List Inv. Names 19. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 56, 57, 59, 73, 89, & 90. 1942; P'ei, Bot. Bull. Acad. Sin. 1: 6. 1947; H. N. & A.

L. Mold., Pl. Life 2: 53. 1948; Mold., Alph. List Cit. 4: 1136. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 131, 136, 159, 180, & 182. 1949; Mold., Résumé 169, 175, 216, 266, 448, & 451. 1959; Wang, Forests China 111. 1961; Mold., Résumé Suppl. 15: 18. 1967; El-Gazzar & Wats., New Phytol. 69: 459, 483, & 485. 1970; Mold., Fifth Summ. 1: 288, 300, 359, & 450 (1971) and 2: 869. 1971; El-Gazzar, Egypt. Journ. Bot. 17: 75 & 78. 1974; Hu, Journ. Arnold Arb. 61: 87. 1980; Lauener, Notes Roy. Bot. Gard. Edinb. 38: 484. 1980; Mold., Phytol. Mem. 2: 277, 291, 350, & 539. 1980; Mold., Phytologia 60: 142 & 181. 1986.

A shrub or small tree, 6--15 m. tall; trunk to 30 cm. in circumference, 15--24 cm. in diameter at breast height; bark gray or light-gray, smooth; branches subtetragonal or terete, lightly and softly velutinous-pilose with tawny-gray or golden-fulvous hair; leaves decussate-opposite; petioles elongate, 3--10 cm. long, velutinous; leafblades broad, chartaceous, oval or broadly ovate, 15--23 cm. long, 7--14 cm. wide, apically acutely acuminate or caudate, marginally entire, basally truncate or subcordate, pale-greenish, sparsely brown-pilose or pilosulous above, densely cinereous-pilose or -pubescent to -tomentose beneath; venation slightly prominulous beneath; secondaries 3--5 per side, ascending, almost straight, slightly prominulous; tertiaries transverse, subparallel; veinlet reticulation invisible; inflorescence terminal, paniculate, very broad, 20--35 cm. long, 20--30 cm. wide, divaricately 3-, 5-, or 7-branched from the base, cinereous-pilose or -villose throughout, the corymbs loose-flowered; pedicels 1--2 mm. long, with 2 minute bracteoles; buds green; flowers inconspicuous, fragrant; calyx externally pilose, during anthesis 3--4 mm. long and 2.5 mm. wide, divided almost to the middle, the lobes 5, lanceolate, slender, elongate, apically subulate-acuminate, about as long as the tube; corolla white, its tube slender, 10--11 mm. long, about 3 times as long as the lobes, subglabrous, the limb 5-lobed, the lobes oblong-elliptic, 3 mm. long, 1.5 mm. wide, apically obtuse, marginally becoming undulate, dorsally pilosulous; stamens finally long-exserted, surpassing the corolla-mouth by about 10 mm., inserted slightly below the corolla-mouth; anthers oblong; fruiting-calyx enlarged, 6 mm. long, 12 mm. wide, red or reddish, irregularly split, reflexed; ovary glabrous; style equaling the stamens; fruit drupaceous, composed of 2 pyrenes, generally enveloped by the accrescent fruiting-calyx, at first green, later red, finally bluish-black or black.

This species is based on *Rosthorn 676* from the high forest at Pên-Sha-Ai, San-ch'uan, Szechuan, China, deposited in the Berlin herbarium, now destroyed. Diels (1900) comments that this species is "Von den tropisch-indischen Arten mit Terminal-Rispe leicht durch die Gestalt des Laubes und der Inflorescenz und besonders durch die pfriemlichen Kelchzipfel zu unterscheiden."

Clerodendron bodinieri was based on *Herb. Bodinier 1721*, comprising material collected by L. Martin in the vicinity of Gan-pin, Kweichow, on July 27, 1897, and material collected by C. Martin at Kouy-yang "le long des remparts et devant la chapelle N. D. de Liesse" on August 2, 1899, and on *Esquirol 788* from Tchéou-pao-tong,

Kweichow, collected on July 23, 1905; *C. cavalerei* is based on *Cavalerie 70* & *167*, collected at Pin-fa, Kweichow, on July 19 and August 12, 1902.

Collectors have found *C. mandarinorum* growing in open woods and at the edges of mixed woods, in partial shade along streamsides, on open hillsides, and on brushy slopes, from 450 to 1600 m. altitude, in flower from June to September and in November, and in fruit in August and October. Wang encountered it in the hills of western Hupeh in association with *Metasequoia*. A vernacular name recorded for it is "ch'ou mao tan shu".

The corollas are described as having been "white" on *Chow 945, Esquirol 3722, Henry 9026, Herb. Bodinier 1721*, and *Tsiang 8528*, "white shading purplish on unfolding" on *Ching 6675*, and "greenish" on *Tsiang 5387*.

On *Tsiang 8528* some of the flowers are insect-galled, quite abnormal and very tubular in form. Ching describes the leafblades as "glaucescent" beneath: he speaks of the species as a common tree in Kwangsi, "quite pretty" when in flower. A bark sample is included on the Steward, Chiao, & Cheo collection cited below.

P'ei (1947) reports that the plant is highly valued by native herbalists for its medicinal properties in the treatment of rheumatism.

Keys to help distinguish *C. mandarinorum* from other Chinese species will be found under *C. henryi* P'ei in the present series of notes [60: 180--181] and from other Indochinese taxa under *C. hahnianum* Dop [60: 141--143].

Fedde & Schuster (1913) cite *Cavalerie 1095, Martin 2365*, and *Martin & Bodinier 1996* from China; Rehder (1934) cites *Cavalerie 70* & *167, Esquirol 788* & *3722, Handel-Mazzetti 10884, C. & L. Martin in Herb. Bodinier 1721, Steward, Chiao, & Cheo 730*, and *Tsiang 7374* & *8528*, all from Kweichow, China. Dop (1935) cites unnumbered Eberhardt and Pételot collections from Tonkin, Vietnam. P'ei (1947) records the species from Szechuan, and in his 1932 work he cites *Wilson 425* & *1587* from Hupeh; unnumbered Bock, Esquirol, and Rosthorn collections from Szechuan; *Mell 412* and *Ying 1238* & *1395* from Kwangtung; and *Esquirol 3722, Handel-Mazzetti 2144, Henry 9026 & 9026a*, and *Martin 1721* from Kweichow. He comments that "This species differs from its allies in its slender elongated calyx-lobes, and its terminal cyme which divides from the base into three, five or seven primary divaricate branches. The types of both of Léveillé's species which I have seen at the Herbarium [of the] Arnold Arboretum, agree very well with the characters of *Clerodendron mandarinorum* Diels, and with the Henry's specimens from Yünnan. The size of the leaves of this species varies very much, from few centimeters up to 33 cm. long, 20 cm. wide. The leaf is usually pilose but *Henry's 9026* and *Wilson, Veitch Exped. 1587* have much denser pubescence and smaller leaves. The axis of the inflorescence is very short about 1.5 cm. in length, the calyx is reflexed and irregularly split in fruit. The Drup [sic] is bluish-black, with few selate [sic] glands, usually of the vas [sic] of the elongated teeth."

Leveille's original (1911) description of C. *bodinieri* is: "Arbor; ramuli indumento fulvo-aureo vestiti, teretes; folia cordiformis, ad basim cordate vel truncata; ad apicem caudato-acuminata integerrima, utrinque subtus praesertim flavido-viridia reticulata; usque ad 35 cm. longa (petiolo 10 cm. longo), et 15 cm. lata supra pilosula subtus tomentosis; inflorescentia latissime et decomposite corymbosa albido-villosa; dentibus calycinis albis corollae albae concoloribus, subulatis, tubum aequantibus; corollae lobis obtusis reflexis; stamina exserta; antheris oblongis." His original (1912) description of C. *cavaleriei* is: "Arbor 6--8 m. alta; ramuli pubescentes; folia obovata, 8--15 x 5--7 cm., supra atroviridia glabrata subtus albescentia et molliter villosa petiolata; flores latissime 15--25 cm. composita, albi, odoratissime; inflorescentia et calyces densissime albido-pubescentes; dentes calycini filiformes; corolla pubescens lobis ovatis, obtusissimis; stamina longe exserta, antheris ovatis, stylum superantia calyx marcescens; nuculae nigrae pisiformaticae." It should be noted that in the former description he speaks of the corolla-lobes being equal in length to the corolla-tube and the calyx with white subulate teeth -- in the latter description he speaks of obovate leafblades. These characters do not fit those seen in typical C. *mandarinorum*.

Material of C. *mandarinorum* has been misidentified and distributed in some herbaria as C. *canescens* Wall.

Citations: CHINA: Hupeh: *Chow 945* (N); *Hwa 40* (Ca--753263); *E. H. Wilson 425* (Gg--32031, Gg--32032, Gg--32033, Gg--32034, Ph, W--777039, W--777049), *1587* (N). Kwangsi: *Ching 6675* (N), *7358* (N). Kwangtung: *Ying 1238* (Ca--359896). Kweichow: *Steward, Chiao, & Cheo 730* (N, S); *Tsiang 4651* (Ca--480440), *5387* (Bz--20024, Mu), *5572* (Mu), *7374* (N, S), *8528* (N, S, W--1575062). Yünnan: *A. Henry 9026* (N, W--456662). VIETNAM: Tonkin: *Pételot 5086* (N). CULTIVATED: Massachusetts: *E. H. Wilson 425* (A, Ld--photo, N--photo, W--photo).

CLERODENDRUM MANDRARENSE Mold., Lloydia 13: 209--210, 1950.

Bibliography: Mold., Lloydia 13: 209--210. 1950; E. J. Salisb., Ind. Kew. Suppl. 11: 56. 1953; Mold. in Humbert, Fl. Madag. 174: 151, 199, 201--202, & 268, fig. 32 (5). 1956; Mold., Résumé 155 & 451. 1959; Mold., Fifth Summ. 1: 260 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 249 & 539. 1980; Mold., Phytologia 58: 187. 1985.

Illustrations: Mold. in Humbert, Fl. Madag. 174: 199, fig. 32 (5). 1956.

A shrub; branches and twigs very slender, grayish, obtusely tetragonal, glabrous, lenticellate, often compressed; nodes not annulate; principal internodes 1--5.5 cm. long; leaves decussate-opposite; petioles slender, 3--6 mm. long, glabrous, flattened and canaliculate above; leafblades chartaceous, rather firm in texture, uniformly bright-green and shiny on both surfaces, elliptic, 5--9 cm. long, 1.7--4 cm. wide, apically acuminate, marginally entire, basally mostly acute, glabrous on both surfaces; midrib slender, prominulous above, prominent beneath; secondaries slender, 5--7 per side, irregular, often indistinct from the veinlet reticulation,

prominulous above, prominent beneath, divaricate or arcuate-ascending, joined in many loops near the margins; veinlet reticulation abundant, conspicuous, prominulous on both surfaces; inflorescence apparently terminal or in the uppermost leaf-axils, 1- or 2-flowered; pedicels about 15 mm. long, ampliate upwards, often curvate; bracts and bractlets obsolete; calyx broadly campanulate, chartaceous, about 3.5 cm. long and to 2 cm. wide, longitudinally venose, glabrous, shiny, the rim 5-lobed, the lobes ovate-triangular, 6--7 mm. long, apically attenuate-acute; corolla infundibular, the tube about equaling the calyx in length and about 15 mm. wide, externally glabrous, the limb about 3 cm. wide when fully expanded; fruiting-calyx and fruit not known.

This endemic species is based on *Humbert 6630ter* from a forest on gneiss laterite on the slopes and summit of Marosoui, at 1000--1400 m. altitude, in the upper basin of the Mandrare River, in southeastern Madagascar, collected on November 14 or 15, 1928, and deposited in the Paris herbarium.

A key to help distinguish this species from other Madagascar taxa in this genus will be found under *C. baronianum* Oliv. in the present series of notes [58: 184--190].

Citations: MADAGASCAR: *Garnier 118* (N, P); *Humbert 6630ter* (E--photo of type, F--photo of type, Ld--photo of type, N--photo of type, P--type).

CLERODENDRUM MANETTI Visiani, Sem. Hort. Patav. 2: 20, pl. 4 [as "*Clerodendron*"]. 1848; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 91 & 94. 1936.

Synonymy: *Clerodendron splendens* Manetti, Cat. Pl. Hort. Modic. Suppl. 2: 9. 1842 [not *Clerodendron splendens* G. Don, 1893, nor Hehl., 1963, nor Hort., 1877, nor Gaertn., 1968, nor (Thunb.) G. Don, 1968, nor *Clerodendrum splendens* G. Don, 1824]. *Clerodendron manetti* Visiani, Sem. Hort. Patav. 2: 20, pl. 3. 1848. *Clerodendron manettii* Vis. apud H. J. Lam, Verbenac. Malay. Arch. 320. 1919.

Bibliography: Manetti, Cat. Pl. Hort. Modic. Suppl. 2: 9. 1842; Visiani, Sem. Hort. Patav. 2: 20, pl. 4. 1848; Visiani, Revis. Pl. Min. Cognit. Hort. Patav. 1855; Schlecht., Bot. Zeit. 14: 477. 1856; Visiani, Ill. Piante Orto Padova 3: 20, pl. 3, fig. 2 a--d. 1856; Visiani, Mem. Istit. Veneto 6: pl. 3. 1856; C. Muell. in Walp., Ann. Bot. Syst. 5: 710. 1860; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 561. 1893; J. G. Baker in Thiselt-Dyer, Fl. Trop. Afr. 5: 301. 1900; H. J. Lam, Verbenac. Malay. Arch. 320 & 364. 1919; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 95, 109, & ix. 1921; Stapf, Ind. Lond. 2: 239. 1930; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 91 & 94. 1936; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 72 & 90. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 561. 1946; H. N. & A. L. Mold., Pl. Life 2: 71. 1948; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 159 & 182. 1949; Mold., Résumé 216 & 451. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 561. 1960; Mold., Fifth Summ. 1: 259 (1971) and 2: 869, 1971; Mold., Phytol. Mem. 2: 350 & 539. 1980; Mold., Phytologia 50: 259 (1982) and 58: 297 & 298. 1985. [to be continued]

BOOK REVIEWS

Alma L. Moldenke

"GUIDE TO THE VASCULAR FLORA OF ILLINOIS" Revised and Enlarged Edition by Robert H. Mohlenbrock, x & 508 pp & 2 b/w maps. Southern Illinois University Press, P. O. Box 3697, Carbondale, Illinois 62902-3697. 1986. $42.50 clothbound & $16.95 paperbound.

The first edition of 1975 has been well appreciated as a very fine state flora, for its importance as a college and self-teaching instrument and as a detailed systematic floral study of 3047 taxa statewide. This new edition is of the same high quality for its thoroughness in treating 3,204 taxa of ferns, gymnosperms and flowering native and naturalized plants. It represents a nearly 5% increase in taxa, modernized nomenclatural revisions, and similar well working keys. Michaux in 1795 was the first to collect specimens in what is now this state of Illinois with its 380 miles from north to south and 200 from east to west. The author also notes the importance of G. N. Jones' "Flora of Illinois" which ultimately listed 2,400 species. If only the county and especially the natural divisions maps and their legends were printed on a larger scale!

"TRANSPORT IN PLANTS" by Ulrich Lüttge & Noe Higinbotham, x & 468 pp., 180 b/w fig. incl. 4 photo. & 33 tab. Springer-Verlag, Berlin, Heidelberg & New York, N. Y. 10010. 1979. $37.00.

It is certainly fortunate for those upcoming advanced and advancing students in this and related fields and for "biologists seeking a review of the various transport processes of minerals and organic substances in plants from the level of cell organelles to the longer-distance movements in the largest trees" to have this excellent treatise still available. It is much more than just a clear English translation of the first author's "Stofftransport der Pflanzen"; it is updated and enriched by the second author-translator. Part I presents the biophysical background and substances of transport (electrical, electrochemical, irreversible thermodynamics, osmoregulation); Part II treats complications of models by cellular structures (cell walls, cell membranes and organelle membranes); Part III discusses regulation and control of transport processes by cell metabolism (respiration and photosynthesis as energy sources, phytochrome, coupling); and Part IV treats intercellular-cellular and inter-organelle (apoplastic xylem, symplastic phloem). Several of the figures are particularly well contructed.

"UNDERSTANDING ENZYMES" by Trevor Palmer, 405 pp., 107 fig. & 15 tab. Halsted Press of John Wiley & Sons, New York, N. Y. 10158. 1st edit. 1981. \$84.85; 2nd edit. 1985. \$45.00.

This logically presented text from the senior lecturer in biochemistry in the Trent Polytechnic of Nottingham, U. K., was first published and used there and now has much wider use through being printed also in the U.S. It intends to serve as an introduction to enzymology with a "balanced, reasonably-detailed account of all the various theoretical and applied aspects of the subject." There are summaries at the ends of chapters as well as lists of related problems to be solved. Enzymes (proteins that specially catalyze living cell reactions often with a non-protein cofactor) have been used for many centuries and now are of added "great importance in scientific research, clinical diagnosis and industry." There are chapters on proteins, monomeric and oligomeric enzymes, enzyme-catalyzed reactions and inhibition, ligand-protein binding, sigmoidal kinetics and behavior, enzyme purification, some biomedical and biotechnical industrial applications. In the U. S. this book should certainly be available as a second text for studying enzymes.

"PHYSIOLOGY OF MOVEMENTS" edited by W. Haupt & M. E. Feinleib, xviii & 731 pp., 185 fig. incl. 74 photo. & 19 tab. Springer-Verlag, Berlin, Heidelberg & New York, N. Y. 10010. 1979. \$100.00.

These carefully prepared studies comprise Volume 7 in the Encyclopedia of Plant Physiology, New Series, and were preceded by 2 volumes - 1959 and 1962 - in the first edition of the Encyclopedia. "The most important aim of this encyclopedia is to stimulate research. The authors have therefore made a special effort to point out unsolved problems." These papers include such topics as: stimulus perception, reception and transduction of electrical and mechanical stimuli, actinomycin as a basic mechanism of movement in animals and plants, chloroplast and nuclear migration, photomovement, chemotaxis in bacteria and unicellular eukaryotes, tendril curling, and epinasty -- all with far more chemical and physical details than the simpler experiments of a decade or score of years earlier. These experimental records and their very detailed bibliographies are still very much needed by advanced students in plant physiology.

"PHOTOSYNTHESIS II. PHOTOSYNTHETIC CARBON METABOLISM AND RELATED PROCESSES" edited by M. Gibbs & E. Latzko, xx & 578 pp., 75 fig.. incl. 5 photo. & 22 tab. Springer-Verlag, Berlin, Heidelberg & New York, N. Y. 10010. 1979. \$99.00.

This book belongs to the Encyclopedia of Plant Physiology New Series and is its Volume 6. The editors in their introduction explain that the volume has as its central theme the Calvin cycle and provides - right on the third page - a detailed diagrammatic "master

scheme for this photosynthetic carbon metabolism and related processes." It is still valid for today, allowing for some verifying intermediate steps. The 37 technical papers are grouped topically under CO_2 assimilation and ferrodoxin-linked reactions. These papers are very well prepared and presented: they still make valuable reading material.

"PRAIRIE WINGS -- The Classic Illustrated Study of American Wildfowl in Flight" by Edgar M. Queeny, xiv & 256 pp., 65 b/w photo, 161 fig. & 1 map. Dover Publications, Inc., Mineola, New York 11501. 1983. $12.50.

This is an unabridged replication of the wonderful "Prairie Wings and Camera Flight Studies" from J. B. Lippincott Company in 1947. The many photos and drawings are special -- beyond being attractive illustrations -- because they catch the birds -- mainly ducks -- in precision photography and drawings in all stages of what is actually involved in the mechanics of flight. They are accompanied by fascinating, easy to follow, technically accurate descriptions of flight stages. The geographical area studied for many years is the mid-continental fall flyway over the Grand Prairie of Arkansas with resting and feeding (and being hunted) stations in the cropped rice fields with their water supply. The addenda discusses the sensory abilities and kinds of ducks.

"LEHRBUCH DER PFLANZEN-PHYSIOLOGIE -- Dritte, Völlig Neubearbeitete und Erweiterte Auflage" by H. Mohr & P. Schopfer, xi & 608 pp., 639 b/w fig. incl. 10 photo. & 35 tab. Springer-Verlag, Berlin, Heidelberg & New York, N. Y. 10010. 1978.

In German language universities this excellent, thoroughly detailed, comprehensive, modern plant physiology text is planned for middle and higher classes. In English and other language colleges and universities this book provides a supplementary text or reference source for senior or graduate courses and really is a "must" for graduate students preparing for professional life in this field. The orientation, content and substantiation are as effectively and thoroughly explained as such a text could be in view of the fact that it must have been prepared for press about a full decade ago! The book is copiously, but not superficially, supplied with pertinent, very well organized illustrations from primary sources or the authors' own constructions. "Biochemie und Physiologie sind Partner".

Inasmuch as we do no editing, papers accepted for publication *must* be submitted in *exactly* the form that the author wants to have them published. They will then be photographed and printed by photo-offset in exactly the form as submitted except that we will add page numbers and running-heads.

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